LABORATORY PRACTICE

RESEARCH · CONTROL · TEACHING

VOL. 8 No. 3 Published Monthly MARCH 1959

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It takes ten years to make a scientist

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And the calorimeter sets are available, not in ten years, but now, at a price at which they will pay for themselves in a matter of months.

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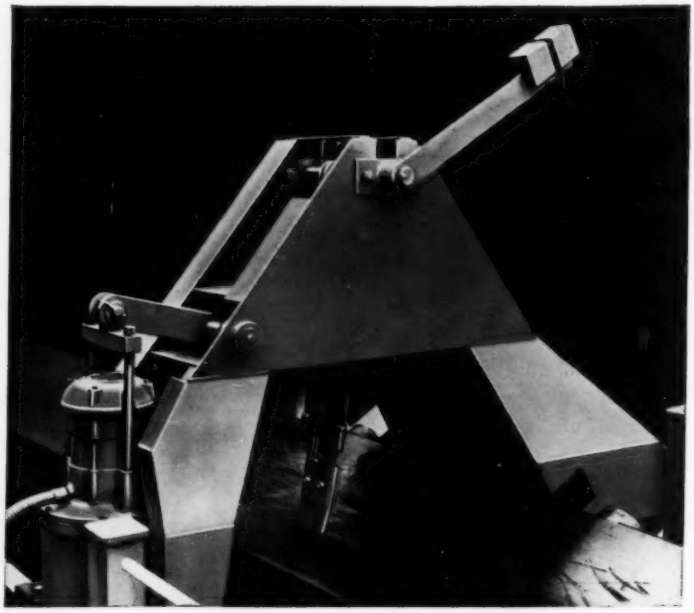
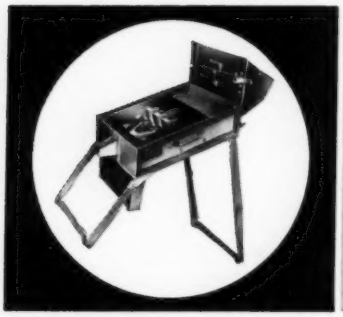


The IC POLLOCK Sampler



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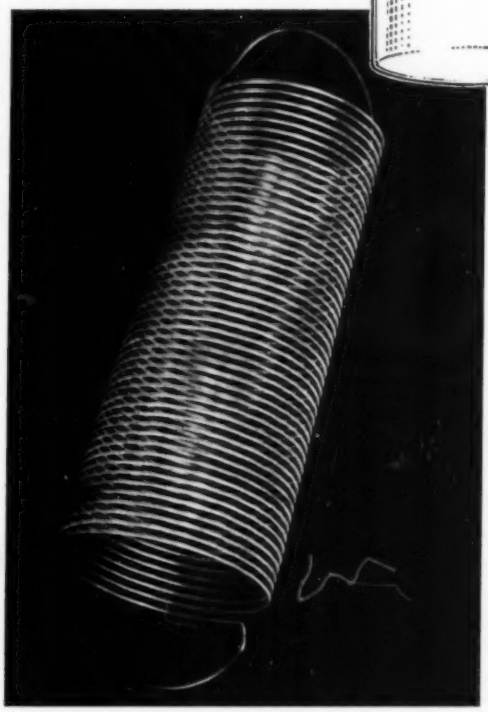

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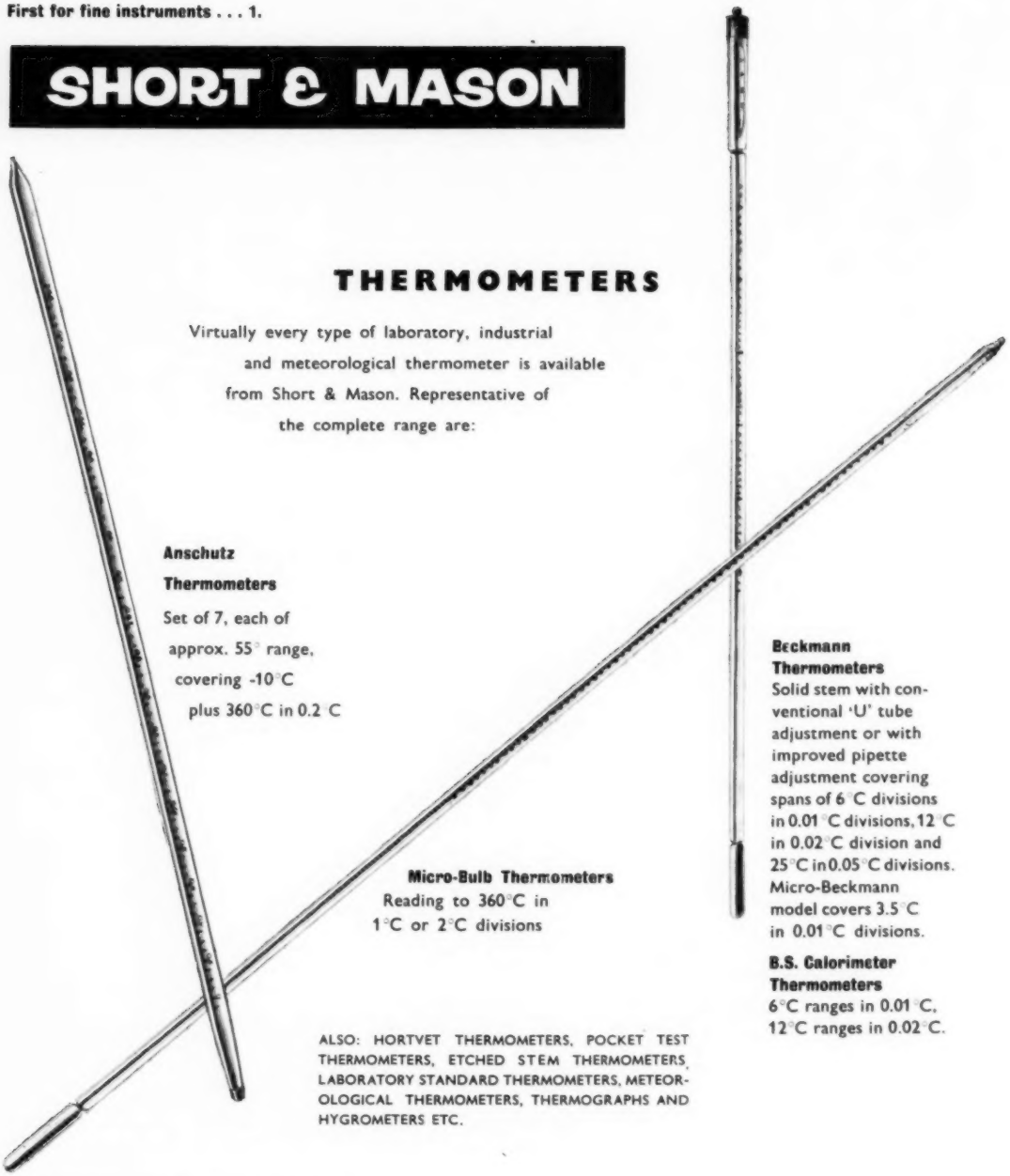

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Beckmann Thermometers
Solid stem with conventional 'U' tube adjustment or with improved pipette adjustment covering spans of 6°C divisions in 0.01°C divisions, 12°C in 0.02°C division and 25°C in 0.05°C divisions. Micro-Beckmann model covers 3.5°C in 0.01°C divisions.

B.S. Calorimeter Thermometers
6°C ranges in 0.01°C, 12°C ranges in 0.02°C.

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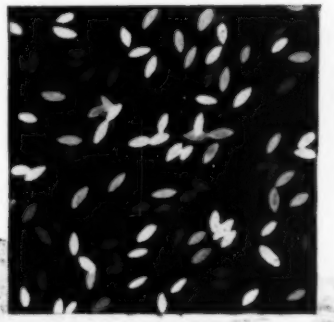

Chromobacterium Prodigiosum: it grows rapidly at room temperature, producing a brilliant red pigment

The day the milk turned red

The Dairyman was understandably perturbed. A consignment of milk had turned red before bottling. Immediate laboratory investigation was set in motion; a chromogenic organism was isolated and identified as Chromobacterium Prodigiosum on Oxoid Culture Media.

We recommend for the cultivation of this organism Mannitol Peptone Agar (pH 6.8) and we find that chromogenesis is enhanced by incubation at room temperature in diffuse daylight.

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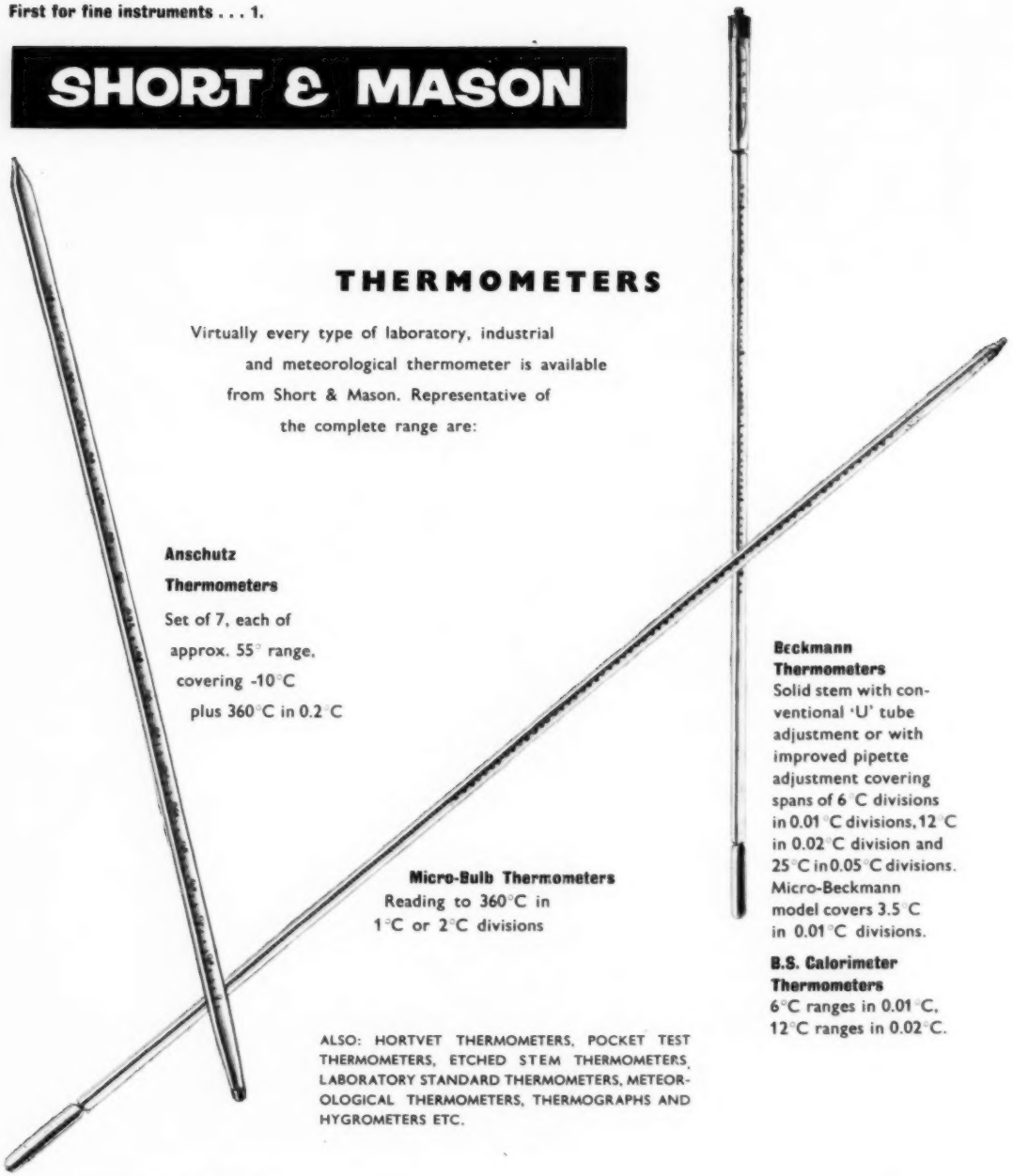

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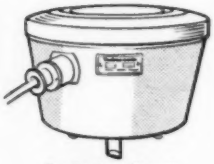

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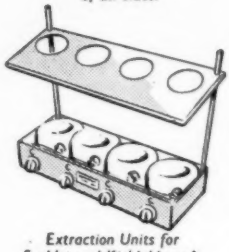
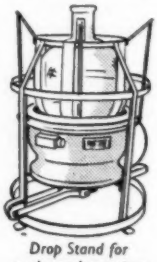


Extraction Units for Soxhlet and Kjeldahl work



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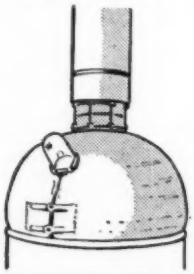

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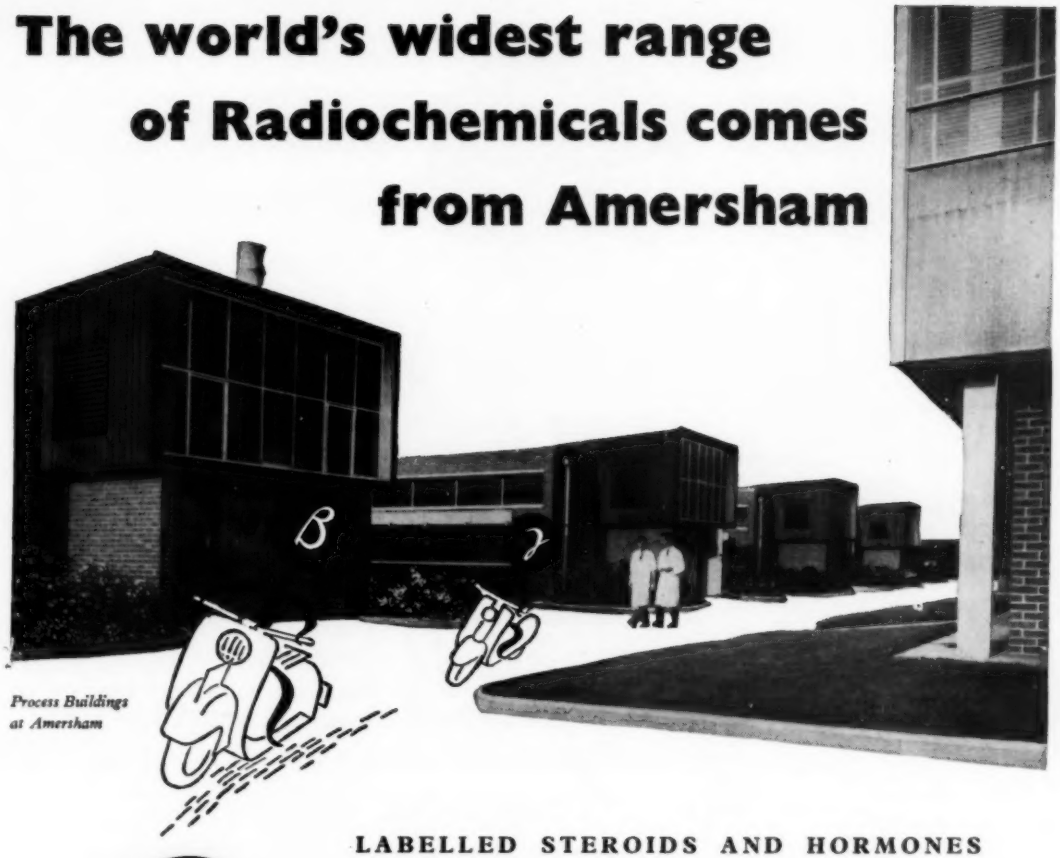

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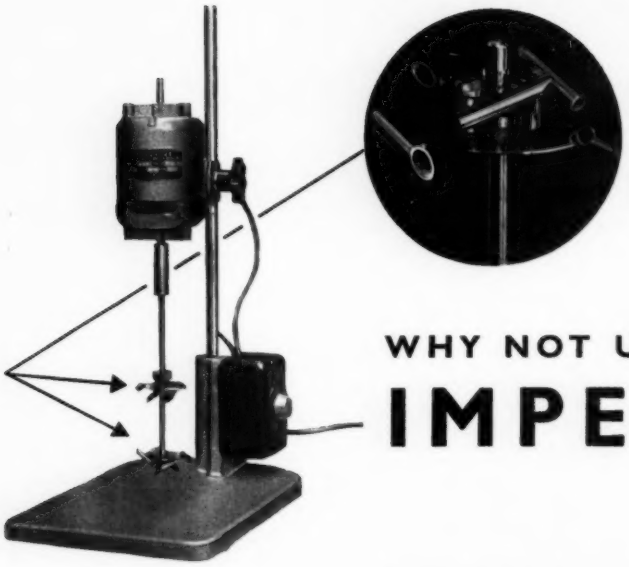

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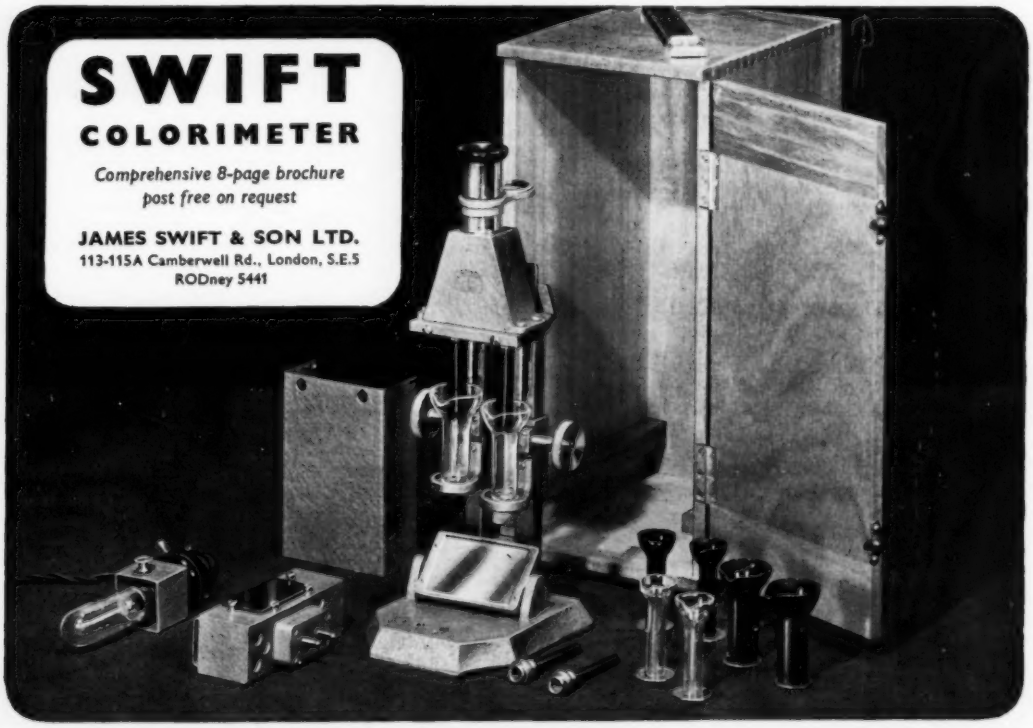

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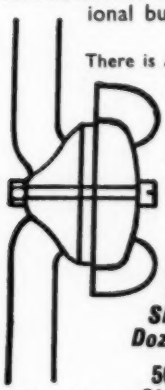

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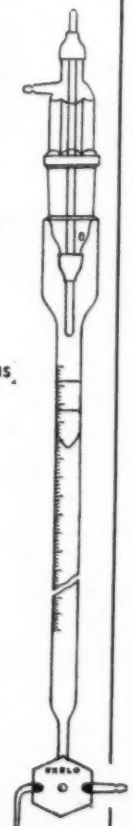

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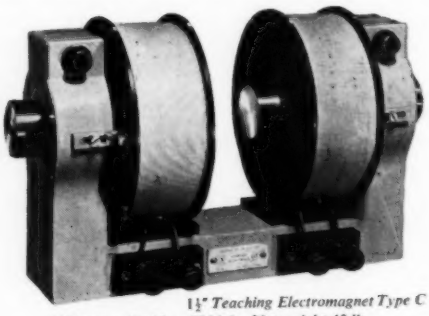

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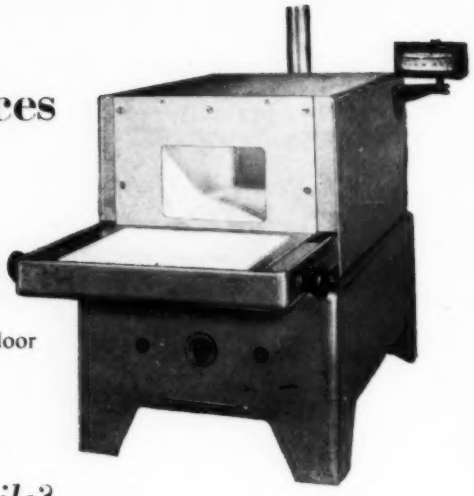

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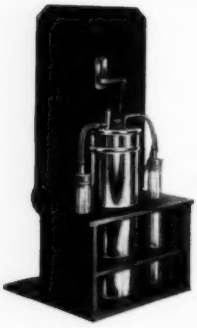

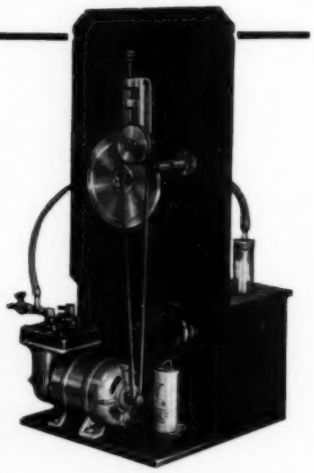

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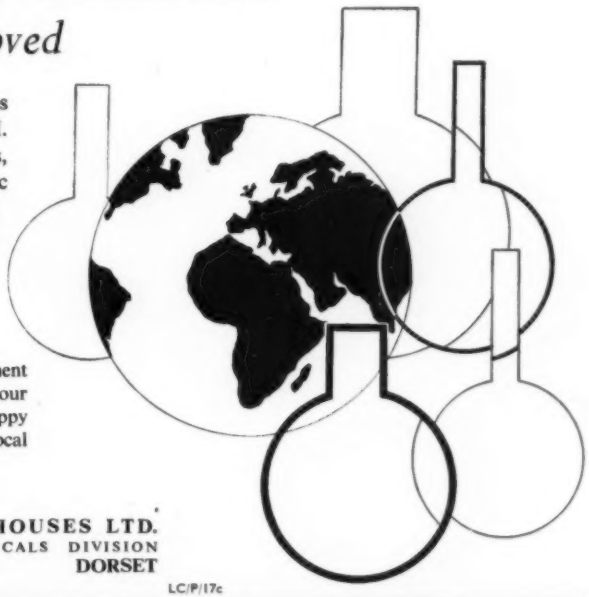

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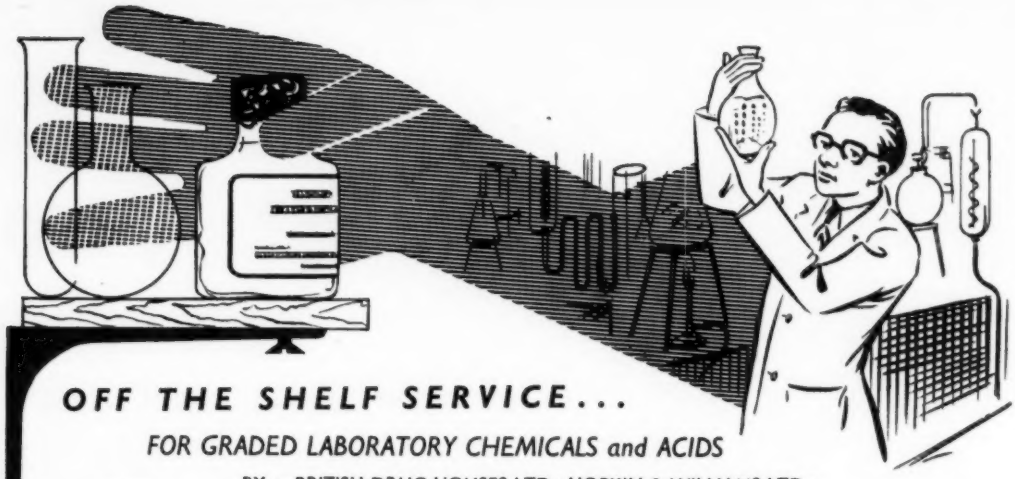

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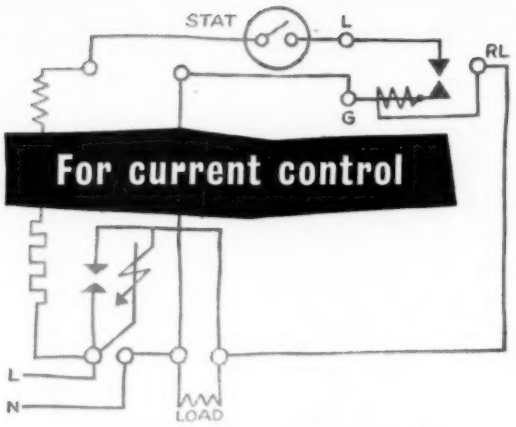

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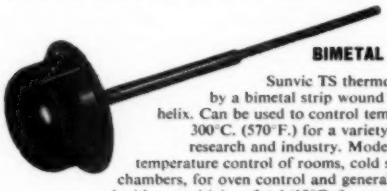

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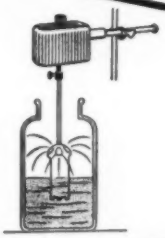

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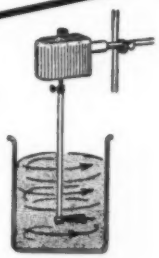

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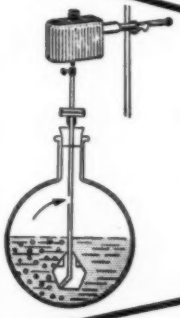

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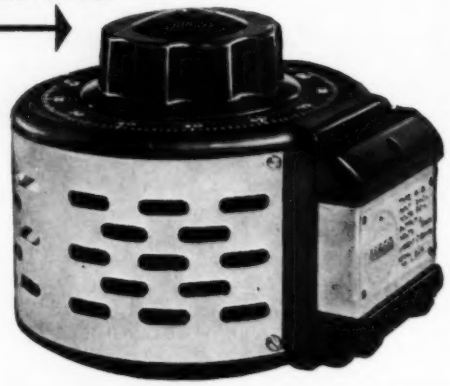

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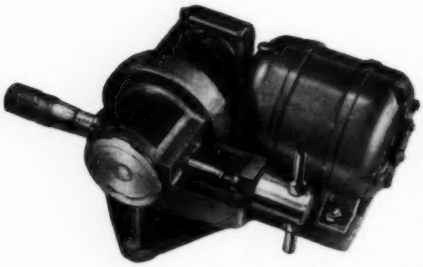

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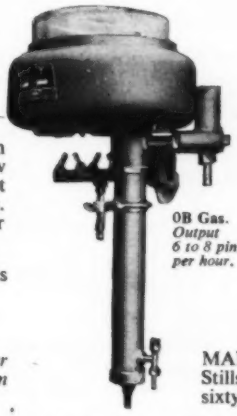

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EDITORIAL

The Rockefeller Foundation

IN an age when selfishness and aggression by individuals and nations are as dominant as ever, it can afford us some pleasure to give thought to those who, when favoured by ability and circumstance, have made provision for helping mankind. One of the most famous of its kind, the Rockefeller Foundation has just issued its annual report which once again records its unceasing work for science, medicine and philanthropy.

In 1957 nearly 43 million dollars were spent, including over eight million for medical education and public health, over five million for medicine and biological research, and over five million for work in agriculture. Altogether 248 persons received fellowships, and 532 persons from 53 countries undertook research or received advanced training in 104 institutions in 20 countries. The total number of grants for all purposes was 737.

In addition to the vast material benefits which the work of the Foundation brings there are many facets often unnoticed but not less important. Perhaps the most pleasing is the fact that the approach is completely devoid of politics. It is difficult to find any country of any size which is not benefiting in some way or other. Race, religion, political creed, geographical location, and degree of civilization or technical advancement are all of no account. The aspiration is not to conflict but to co-operation. The fight is not against men or nations, but against hunger, disease and ignorance. The weapons are not pious hopes and impractical idealism but hard-headed realism and efficient planning. The avowed policy of the Foundation is that knowledge, health, and an adequate livelihood are the factors most likely to turn possible enemies into certain friends.

It is not surprising that the universities have received the greater part of the funds allocated by the Foundation, and that the centres offering hospitality were originally largely European but are now increasingly American. During the 50 years of the Foundation's history, medicine, science and technology have probably made greater relative progress in U.S.A. than in any other country. American scientists have for long been

famous for their willingness to help others and share their knowledge, and it is to be hoped that this attitude will spread throughout the world. Even business men today realize that secretiveness rarely pays in the long run, and that a helpful attitude to others and publication of research findings yield a good dividend ultimately. No secret remains a secret for long. The international science struggle is a marathon in which the leader is constantly changing, and there is always someone breathing over his shoulder. It is not a knock-out competition in which ultimately there is only one survivor. This world will never realize a permanent peace until the spirit of interchange of ideas and co-operation in implementation of knowledge are applied in the realms of economics as they are already applied in those of science and culture generally.

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This Register has been compiled by The Laboratory Animals Centre. M.C.R. Laboratories, Woodmansterne Road, Carshalton, Surrey, (Telephone: Wallington 5512) and is correct as at January 7, 1959.

ORIGINAL CONTRIBUTION

A NOTE ON THE ORAL TOXICITY OF FLUOROACETOISOBUTYLAMIDE AND ITS INHIBITION BY ACETAMIDE

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BERGMANN, Moses, and Neemen (1957) found the oral LD_{50} (rat) for fluoroacetoisobutylamide to be 42 mg./kg. The experiments described in this note were designed to check this value.

Procedure

The substance was administered by stomach tube as a 5 mg./ml. aqueous solution to albino rats of the Tuck strain, derived originally from the Wiston strain. The rats employed were about eight weeks old, and were within the weight range of 80-120 g. They were dosed after a fasting period of 16 hours, while the period of observation was seven days from the time of dosing.

In all tests equal numbers of males and females were employed; but the resultant responses showed no sex-difference.

Results

A number of trial runs on groups of four rats indicated that the LD_{50} was below 30 mg./kg. The results were as follows:

Dose in mg./kg.	*Deaths*
60	4/4
50	4/4
45	3/4
40	4/4
30	4/4

A larger series was then constructed in the light of these findings, and the results, which were employed in the construction of the dose-response curve, are set out in Table I. The LD_{50} calculated from the dose-response curve is 17·5 mg./kg. (Fig. 1).

The observed symptoms shown by the test rats were lethargy and ruffled coat occurring about 40 minutes after dosing, followed by muscular fibrillation or unsteady gait which developed into violent convulsions. Death occurred after a brief coma within two to 60 hours after dosing.

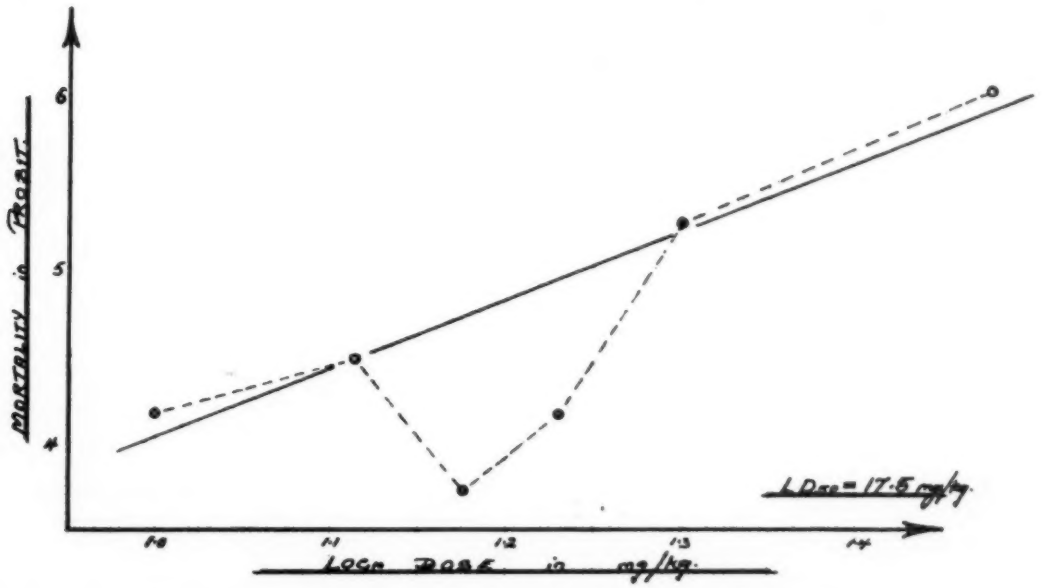

Fig. 1. Dose-response curve of acute oral toxicity of fluoroacetoisobutylamide.

TABLE I

Data on Fluoroacetoisobutylamide. LD_{50} = 17·5 mg./kg.

Dose in mg./kg.	*Log 10 dose*	*Deaths*	*Mortality probit*
10	1·000	2/10	4·158
13	1·114	3/10	4·476
15	1·176	1/10	3·718
17	1·230	2/10	4·158
20	1·301	6/10	5·253
30	1·477	10/10	6·030

TABLE II

Data on Fluoroacetoisobutylamide and Acetamide

Dose in mg./kg.	*Log 10 dose*	*Deaths*	*Mortality probit*
15	1·176	2/10	4·158
20	1·301	4/10	4·747
25	1·398	3/10	4·476
30	1·477	4/10	4·747
40	1·602	7/10	5·524
50	1·699	8/10	5·842

Seventy-five per cent of all the deaths occurred on the first day of the test, and no death occurred after the third day.

Discussion

The LD_{50} of the supplied fluoroacetoisobutylamide is considerably less than that stated to have been found by Bergmann *et al.*, viz. 17·5 mg./kg. as against 42 mg./kg. The difference is of such magnitude that it cannot be attributed to response variation due to the different strains of rats employed. Fluoroacetoisobutylamide is in fact of the same degree of toxicity as fluoroacetamide (Phillips and Worden, 1957). In the case of fluoroacetoisobutylamide the toxic symptoms seemed more severe than those reported by Phillips and Worden (*loc. cit.*).

The Inhibitory Action of Acetamide

Inhibition of the toxic effect of fluoroacetoisobutylamide and acetamide was also investigated. A 1:4 weight-for-weight mixture of fluoroacetoisobutylamide and acetamide, in aqueous solution at a concentration of 5 mg./ml. of fluoroacetoisobutylamide was tested for its toxicity with the results shown in Table II.

The dose-response curve was constructed from those results, and the LD_{50} calculated to be 30 mg./kg. (Fig. 2). This showed that the presence of acetamide significantly inhibits the toxic action of fluoroacetoisobutylamide and in the presence of four times the quantity of the latter substance acetamide will raise its LD_{50} from 17·5 mg./kg. to 30 mg./kg., i.e. by about 70 per cent. The symptoms followed the same pattern as those resulting from administration of fluoroacetoisobutylamide alone. This observed inhibition is in accordance with the findings on acetamide and fluoroacetamide (Phillips and Worden, *loc. cit.*). There is therefore a marked similarity in the degree and pattern of the toxicity of fluoroacetoisobutylamide and of fluoroacetamide. It may therefore be concluded that the substituted isobutyl radical in the amino group has no appreciable influence on the toxicity of the substance.

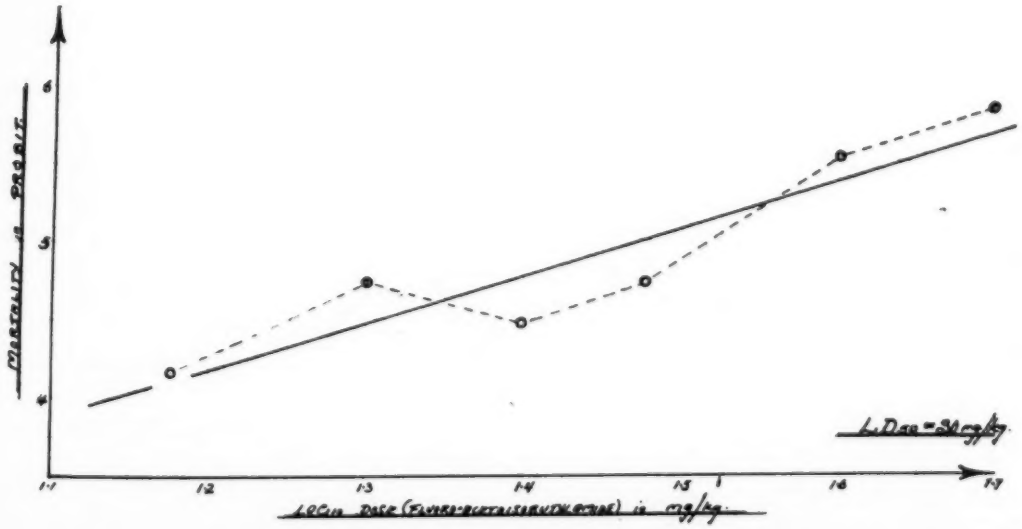

Fig. 2. Dose-response curve of acute oral toxicity of a 1:4 mixture of fluoroacetoisobutylamide and acetamide.

Summary

1. The LD_{50} of fluoroacetoisobutylamide has been found to be 17·5 mg./kg. when administered orally to rats by stomach tube as a 5 mg./ml. aqueous solution.
2. The chief symptoms of its toxic effect are muscular fibrillation, violent convulsions, coma and death resulting in from two to 60 hours.
3. Marked inhibition of the toxic effect of fluoroacetoisobutylamide was observed when the substance was administered together with four times its weight of acetamide: the oral LD_{50} in this case was 30 mg./kg.

ACKNOWLEDGMENTS.—*We are grateful to Associated Fumigators Limited, through Dr. M. A. Phillips and Associates, for the supply of fluoroacetoisobutylamide.*

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Recent Advances in Structural Inorganic Chemistry

A meeting of the Kent Sub-Section of the Royal Institute of Chemistry was held on October 28 at the Medway College of Technology, Chatham. Dr. C. Simons presided and introduced Prof. R. S. Nyholm to an audience of about 70 of whom nearly half were members of the Institute.

Nickel is known to exhibit all the five oxidation states from 0 to +4. In the zerovalent state, e.g. $Ni(CO)_4$, the compounds are tetrahedral. At the other end of the scale, complexes of Ni(IV), e.g. K_2NiF_6, which is diamagnetic, are usually octahedrally co-ordinated. The complexes of tervalent nickel are either five-covalent, e.g. $NiBr_3,2Et_3P$ or six-covalent, e.g. $[Ni(Diarsine)_2Cl_2]$ Cl. The former are presumably square pyramidal in shape while the latter are probably teragonal like the derivatives of bivalent palladium of the type $PdI_2.2Diarsine$. Little is known of the stereochemistry of univalent nickel complexes having the formula $K_2Ni(CN)_3$; from its diamagnetism this compound is apparently dimeric.

Bivalent nickel gives rise to two kinds of complexes, some of which are diamagnetic and others which have two unpaired electrons. The diamagnetic complexes are either four-covalent and square, e.g. $NiCl_2.Et_3P$ or five-covalent and presumably square pyramidal, e.g. $NiBr_2$.triarsine. The paramagnetic complexes are usually six-covalent with an octahedral stereo-chemistry, e.g. $[Ni(NH_3)_6]Cl_2$. However there has long been doubt as to the existence of four-covalent paramagnetic nickel complexes. Until recently only the compounds $(Ni)NO_3)_2.2Et_3P$ and $Ni(Acetylacetone)_2$ were believed to involve four-covalent nickel.

The latter has been shown to be a trimer, probably involving six-covalent nickel, while the former could, at least theoretically be formulated with a chelated nitrate group making the nickle atom six-covalent.

Recently Venanzi and Powell have shown clearly that the paramagnetic compound $NiBr_2.2Ph_3P$ involves tetrahedrally co-ordinated nickel, there being considerable distortion from the regular tetrahedral angle. Investigation by Dr. Naida Gill and Peter Pauling at University College, London have also added to our knowledge of this problem. In connection with some studies of the structures of compounds of the type $M^{II}(Hal)_2.2Pyridine$, salts of the general formula $(Ph_3MeAs)_2$ $(M^{II}Hal_4)$ have been prepared. As expected from the application of ligand field theory, those complexes wherein the metal atom has a d^5 (mnII), d^7 (CoII), or d^{10} (ZnII) non-bonding electronic configuration are isomorphous and are bi-univalent electrolytes in nitrobenzene; since the magnetic moment and colour of the Co(II) complex is that expected for tetrahedral co-ordination it is concluded that all these compounds are tetrahedral. It was found that the corresponding Ni(II) complexes can be obtained also, where Hal=Cl, Br and I. These compounds are isomorphous with their cobalt analogues and X-ray studies on single crystals establish that the Ni(II) atom is tetrahedrally co-ordinated. The very high magnetic moment (3·9 B.M for the chloride) indicates the high orbital contribution expected for tetrahedral co-ordination. An explanation of the existence of these four-covalent nickel complexes may be advanced in terms of Pauling's Electroneutrality Principle and the importance of covalent bond formation. The simple crystal field theory holds for purely electrostatic complexes and the presence of covalent binding can lead to co-ordination numbers other than which the simple electrostatic theory predicts. The circumstances under which crystal field stabilization energies may be unreliable were discussed.

U.S. Appoint Science Officers

The U.S. Department of State announces the re-establishment of its overseas Science Officer Programme with the appointments of seven distinguished scientists who will serve as Science Officers in the United States embassies in London, Paris, Rome, Bonn, Stockholm, and Tokyo. Although assigned to a specific embassy, the Science Officer will also provide scientific assistance in our embassies in adjacent areas. The men selected are: Dr. Thomas H. Osgood, Dean, School for Advanced Graduate Studies, Michigan State University, for London; Dr. Edgar L. Piret, Professor of Chemical Engineering, University of Minnesota, for Paris; Dr. Edward H. Cox, Retired Head of Department of Chemistry, Swarthmore College, as Deputy Science Officer for Paris; Dr. Walter Ramberg, Chief, Mechanics Division, National Bureau of Standards, for Rome; Dr. Ludwig F. Audrieth, Professor of Chemistry, University of Illinois, for Bonn; Dr. Julian E. Mack, Professor of Physics, University of Wisconsin, for Stockholm; and Dr. Willis R. Boss, Professor of Zoology, Syracuse University, for Tokyo.

These appointments, which will be for a period of two years, constitute the first of a series for the Science Programme of the Department of State under Dr. Wallace R. Brode, Science Adviser to the Secretary. Still to be appointed are Science Officers for U.S.S.R., India, and South America, and Deputy Science Officers for all the posts with the exception of Paris to which Mr. Cox is being assigned. Leaders in science who have had experience as educators, research scientists, and administrators have been specially selected for these posts because of their international scientific reputation, and their knowledge of the status of science and acquaintance with scientists in the country of assignment. Each of the appointees also has a facility with the language of the country of assignment. The high standards set for the selection of these men have been maintained in these appointments. A Science Officer's primary role will be to serve as an Adviser to the Ambassador and his staff in the evaluation of the interaction of science with foreign policy, the assessment of current scientific progress abroad and the enhancement of the liaison between United States and foreign scientists and engineers. Physics, Chemistry, Engineering, and Zoology are the disciplines represented in these initial appointments.

These appointments have been encouraged and urged by the scientific community both at home and abroad. There are 24 countries which have scientific attachés in their Embassies in Washington, attesting to the need and usefulness for representation of science in international affairs.

NEW DEVELOPMENTS IN THE PHYSICAL CHEMISTRY LABORATORY

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PART I—NEW DEVELOPMENTS IN PAPER CHROMATOGRAPHY TECHNIQUES

The following series of papers describe the new or improved methods and techniques which have been developed by the author for use in research projects, in teaching degree, A.R.I.C. and postgraduate students and those in special courses in a physical chemistry laboratory.

A. Circular Paper Chromatography Using a Bridge System

Circular paper chromatography* is known to result in rapid separation of many substances, in the form of arcs or circles, and several variations of the method are now well established. One variation is that involving the placing of a single spot on a tongue cut off the paper, at a short distance from the junction of the tongue from the rest of the filter paper. However, such a procedure enables only one 'spot' to be examined and does not enable direct comparison with other substances. Several tongues can be cut thus enabling the same number of spots to be examined; the resulting arcs are correspondingly smaller in length. Instead of using only unknown spots, some of the tongues can be used for known substances to enable comparison and identification. However, exact comparison is difficult because of the unequal flow of solvent in different radial directions.

In order to enhance optimal arc formation and reproducibility, it is essential that the spot be placed in such a way that the solvent does not flow *around* it, as this results in partial or no spreading of the arc. The use of tongues also leads to difficulties because of the occasional curling up out of reach of the chromatographic solvent, and this is followed by a break in the continuity of solvent flow which is essential for accurate chromatographic development. To overcome this difficulty we have developed the following technique which employs the principle of a paper bridge system associated with a wick (Fig. 1).

In the diagram given, the central position (A) is a circular hole into which a paper wick, or some other type of wick, is introduced prior to the chromatographic run. The spaces marked (Y) have been cut out of the paper, thus leaving the intervening paper bridges between the main body of the paper and the ring of paper (Z) surrounding the central portion, or hollow (A). The spots of the solutions to be examined are placed on the bridges at the points marked (X) and are dried in the usual manner, followed by the chromatographic run.

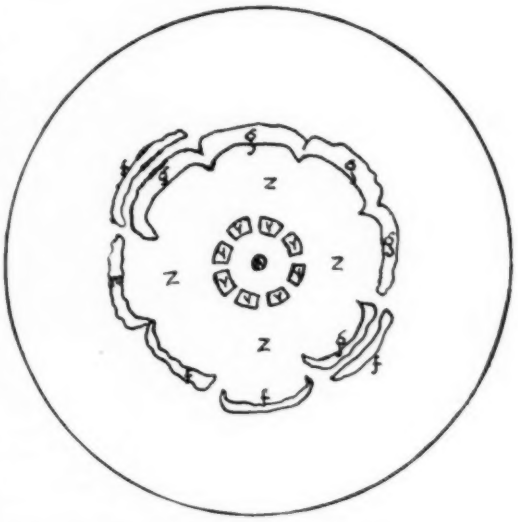

Fig. 1. Circular paper with bridges, showing chromatograms of glucose, fructose and mannose.

To ensure identical cuttings, a template made of a circular aluminium sheet, through which the appropriate design has already been cut, has been employed. The circular paper is placed on clean hardboard paper or some other suitable surface, the template is placed on it, and the pattern is cut out. Alternatively, the pattern is marked on the paper with pencil and is subsequently cut out with either a razor blade or fine scissors.

Types of Wicks

Several types of wicks have been tried in various laboratories. The most prominent of these are the capillary tube type and the paper wick type. The latter is made manually by rolling suitably cut chromato-

*For general details and methods of circular and arc paper chromatography see Rutter (1948), Zimmerman and Nehring (1951). Müller and Clegg (1951), Marchal and Mittwer (1951), Bersin and Müller (1952), Rosebeck (1950), and Berlingozzie and Serchi (1952).

graphic paper which is then pushed through the hole in the centre of the circular chromatographic paper. Owing to its larger cross-sectional area, the use of a paper wick results in more rapid solvent flow. It has the further advantage that the wick can be made initially to be in close touch with the ring of the surrounding chromatographic paper, whereas the paper on top of the glass capillary often curls up, thus breaking the solvent flow. However, repeated use of the same glass capillary has the advantage of increased probability of reproducibility, while such a repetition procedure cannot be applied in the case of paper wicks which have to be freshly made for each chromatographic run. Further, care must be taken to avoid contamination of the paper by the aminoacids present on the surface of one's skin*. To overcome the few disadvantages of this paper wick technique we developed the following methods:

(i) The rolled paper wick is first introduced into a glass tube whose internal diameter is equal to that of the hole (A) and whose length is equal to the height of the horizontal position of the circular chromatographic paper above the bottom of the tray containing the chromatographic solvent (Fig. 2). In order that the circular paper be kept in a horizontal position, it is necessary that both rims of the glass tube be flattened or ground as far as possible.

A useful modification of this development is to employ a *hollow* ring wick instead of a solid one. For this the paper is rolled on a glass tubing having an external diameter smaller than that of the outer glass tube (OG). The difference in diameters should be such as to allow the hollow paper roll to be of three or four thicknesses (Fig. 3). This method requires less paper for the wick, and consequently a smaller amount of solvent is used up by the wick's sorption. This may be important when expensive solvents have to be used. If considered advisable, a further glass tube may be placed on top of the wick and the circular paper, as shown in the dotted lines. This serves as an extra precaution to keep the circular paper in a horizontal position.

(ii) The wick is made up of asbestos powder, or paper pulp which is placed in a glass tube. The procedure involves filling a glass tube of the correct height as before, followed by flat pressing of the wick material. The circular chromatographic paper need no longer have the central hole (A)**. The filled tube is placed into position under the circular paper, as before, and a glass weight, or some other suitable material, is placed above the paper to ensure contact between the wick and the paper. This method can be modified to result in a hollow wick as in the previous method.

It is pertinent to consider Kawerau's circular paper chromatographic method in this connection. Kawerau developed the pattern in which five radial sections were

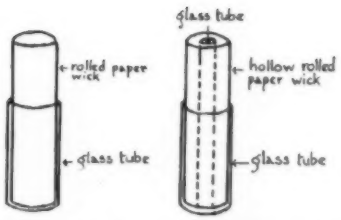

Fig. 2. (left) Solid rolled paper wick with partial glass cover.
Fig. 3. (right) Hollow rolled paper wick with partial glass cover.

separated from one another by cutting out intervening narrow sections of the paper. Such a technique ensures that there is no overspreading of the solvent from one section to another. However, repeated checks in this laboratory have shown that the bridge method developed by the author gives consistent and reproducible results and that these are as easily interpretable as the results obtained by other circular chromatography methods. Further, whereas the Kawerau paper, owing to weakness arising out of the radial cuts, tears quite often during the process of chromatographic development, the bridge circular paper remains in one piece. The latter also tends to curl up far less than the former.

B. Bridge Methods in Comparison of Unidirectional and Arc Paper Chromatography

Unidirectional paper chromatography is now generally used for both separation of mixture constituents and their determination by assessment of their R_F values. Circular paper chromatography as applied horizontally is faster and leads to a better separation of the individual constituents in the form of circles or arcs. Direct comparison of the R_F values obtained in unidirectional chromatography with those obtained by the circular method is complicated by the unequal sideways spreading of the solvent front in the latter (associated with the different directions along the paper). However, the superior separation of the mixture constituents encountered in the circular method is often sufficiently striking to make comparison between it and the unidirectional method desirable. For example, when a glycine solution kept under toluene* for several months is examined by unidimensional ascending paper chromatography, it gives a ninhydrin stainable spot which is somewhat elongated, but which could be attributed to irregular solvent movement. However, when horizontal circular paper chromatography is applied, using the same chromatographic solvent (e.g. pyridine: n-butanol: water) the presence of two arcs stainable with ninhydrin can be easily demonstrated, thus showing the development of an additional compound. Such developments make *direct comparison* of unidirectional and circular paper chromatography of considerable interest. We have therefore developed a simple technique whereby such a comparison is made

*Contamination may be avoided by very thorough washing of the hands with a suitable detergent, followed by the use of a clean dry towel. Alternatively rubber gloves may be employed.

**The central hole is useful in that it may be relied on to keep the position of the wick steady.

*Used as bacteriostatic agent.

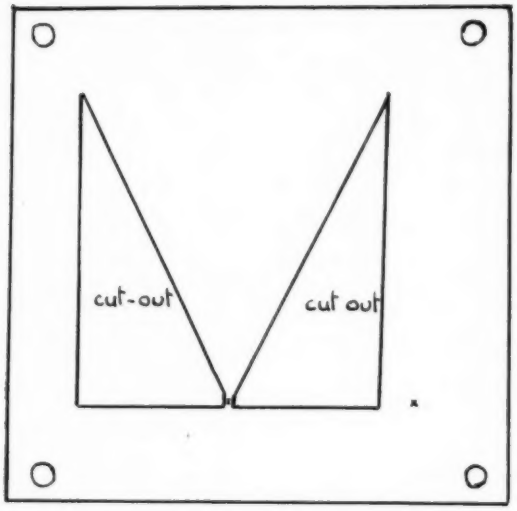

Fig. 4. Vertical, radial and unidirectional chromatogram.

side by side using the same paper and the same experimental conditions. The procedure involves using a paper mounted on a frame, e.g. the usual ten inch square paper which is mounted on a duralumin or polythene frame. Sections of the paper are cut out, as shown in Fig. 4, *before* mounting on the frame. When mounted in a straight frame with the usual drilled paper, the system can be used for ascending chromatographic techniques. Several modifications of the system are possible in which the chromatographic runs are arranged *horizontally*. Several of these including a method allowing a number of papers to be run simultaneously, by means of a special frame easily removable for drying, will be described separately.

C. The Use of Impregnated Barrier Sections in Paper Chromatography

The cutting out of some paper from a given paper sheet or circle results in overall weakening of the surrounding paper and a greater tendency to curl when wet, which may result in a break in the chromatographic solvent flow. Moreover, the paper may tear more readily when wet during chromatographic development or when caught accidentally. It is therefore useful to have some other method which can be substituted for the paper cutting, viz. a barrier method.

The principle of the barrier method is to block the capillaries and also deposit sufficient amount on the surface of the chromatographic paper of a substance which is impervious to a specified, and if possible all, chromatographic solvents. When applied in streaks, or over areas it should separate efficiently certain portions of the paper. Hence instead of cutting the paper it should be sufficient to apply the barrier solution, by painting or some other method; this would soak into the capillaries. After drying, the impregnated sections of the paper would become impervious to those solvents to which the final dried product is impermeable.

The principle has been applied by the author, using various substances and solvents to the bridge circular paper and for direct comparison of circular and unidirectional paper chromatography described in the previous sections*. Solutions of Perspex, polythene, epoxy-resin preparations and phenol-formaldehyde-resin preparations were applied to marked areas on the paper, were dried or 'cured' as necessary, and were then tested by solvent flow. The polythene deposition method has, so far, failed to produce an effective barrier, possibly due to the deposition of the monomer instead of the polymer**. The Perspex deposition method has been found to be only partially satisfactory, because Perspex is attacked by some solvents. The phenol-formaldehyde-resin deposition method proved to be the most satisfactory one in that, when applied correctly, it resulted in a satisfactory barrier to many chromatographic solvents and being coloured can easily be distinguished from the surrounding white surface of the paper, thus doing away with the need for initial pencil marking.

Suggested Procedure: Use a 2 per cent phenol-formaldehyde preparation in industrial methylated spirit. This is stable at room temperature. Apply with a fine brush to the particular surface (the solution does not spread by capillarity). Dry, using a warm or hot air current from a 'hair drier'. Repeat twice, making certain that a sufficiently thick layer is dried on to ensure the surface being covered properly. Place in an oven at c. 110°C. for two to four hours, when 'curing' is complete. Several papers can be treated simultaneously by this procedure and stored until required.

Note: When using horizontal circular paper chromatography, substitution of impregnated barriers for cut out sections, owing to the resulting absence of free passage, results in hindrance to vapour flow and therefore in establishment of vapour-solvent equilibrium. It is therefore advantageous to punch holes, using a clean cork-borer, near the periphery of the circular paper, or well within the boundaries of the areas which have been impregnated, thus enhancing attainment of the required equilibrium.

ACKNOWLEDGMENT.—*I wish to thank Mr. R. Stichbury, B.Sc., for supplying the formaldehyde-phenol solutions, the epoxy-resin preparations, and curing agents.*

(To be continued)

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*The use of Teflon resin dispersions for the formation of chromatographic paper barriers has been suggested for separation of closely placed spots in unidirectional paper chromatography by Usdin (1955).

**Further tests are continuing in this connection, and the results will be published in due course.

PSYCHOLOGICAL ASPECTS OF LABORATORY WORK

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PART VI—SOME WIDER HUMAN PROBLEMS (SECTION 2)

Introduction

This article follows on directly from the previous one in which the general theme of the wider human aspects of laboratory work was introduced. A review was made of the principal activities involved in laboratory work. This was followed by a summary of recent observations on age and creative achievement, a topic which is closely related to the work of the research scientist. After outlining some relevant facts about the effect of environmental conditions upon human performance (with special reference to laboratory work) the previous article ended with an examination of some of the psychological problems involved in establishing recommended standards for environmental conditions.

Further topics under the general heading of wider human aspects of laboratory work are taken up in the present article. The first to be considered is that of the range of individual differences which are of special interest to the psychologist and which have some occupational significance. Observations on differences between groups of individuals lead on logically to the next topic which deals with the general characteristics of the various categories of persons who work in laboratories. Special attention is given to the research scientist and the routine scientific worker or laboratory assistant. Further observations about 'creativity' are included in the discussion of the research scientist. The article ends with a general review of the problems of selection and training for laboratory work. This will form a direct link with the next and final article in this series which will begin with a few examples of selection problems relating to research work and laboratory practice.

Individual Differences

The study of individual differences in human performance and the development of special techniques to 'measure' the principal characteristics of interest forms a major sub-division of modern psychology. There have been several independent streams of thought and work contributing to these developments, which may be approached equally from an experimental or a clinical angle. One important experimental approach has been developed through the study of the functioning of the human senses, a topic already treated in outline in the discussion of the psychophysical methods, which provide certain of the relevant measures of individual performance. Another important approach has been through the 'Mental Test Movement' the detailed history of which cannot be examined here. Attention must be restricted to those individual differences having some bearing upon occupational performance and which can be reliably or consistently demonstrated. These do not necessarily have to be quantitative, although the special advantages of valid, quantitative data are obvious to the reader. The main sub-divisions of these individual differences are:

1. Aspects of sensory functioning. These are examined by special techniques. In general the tasks involved are quite simple psychologically, but complicated apparatus may be required to produce variable forms of stimulation of known and narrowly specified objective characteristics. Tests of colour vision, and of absolute and differential sensitivity for all the human senses belong to this category.
2. The performance of comparatively simple skills involving 'hand-eye coordination'.
3. The performance of moderately complex types of skill consisting of either actual or simulated work-tasks.
4. Aspects of intellectual functioning, probed by means of a wide variety of 'Mental Tests' of a paper and pencil type.
5. Aspects of human 'personality and temperament' which may be assessed subjectively or probed by a variety of tests with varying degrees of 'objectivity' and 'reliability'.

As a matter of general interest, the measures from different groups of tests show some surprising inter-relationships. For example, performance on a simple, repetitive manual task of the 'hand-eye coordination' type has been shown to distinguish between *groups* of neurotic and non-neurotic persons previously classified by normal methods of clinical diagnosis (subjective assessment).

The general question of the reliability and validity of various types of tests has been discussed earlier in the series. Psychological tests vary greatly in their reliability and validity. This matter of reliability is complicated by the important procedural question of how many component items or measures make up the final index number employed. This issue is closely related to the method of increasing the precision of measurement by increasing the number of observations on which the average measure is based. Broadly speaking the most satisfactory scholastic tests of a paper and pencil type in common use have a high reliability; many of them between 0·85 and 0·95 as expressed in terms of a correlation coefficient. Existing methods of probing human personality tend to be the least reliable forms of testing, although it must be admitted that genuine variations in the same individual from one occasion to another are more likely to occur here than the intellec-

tual or 'cognitive' type of tests. (Quantitative evidence on this point is, in fact, very meagre. *See* Anderson, 1958, p. 61).

The question of the validity of a test, the extent to which one measure may be regarded as a satisfactory indication of something else, is a separate one. However, as a highly critical attitude has already been applied to the evaluation of the validity of certain forms of instrumental tests common in laboratory practice, it will also be necessary to examine carefully the validity of available 'psychological tests' as a means of predicting performance in different kinds of laboratory work. However, the first need is to establish whether or not the requirements or special characteristics of various categories of laboratory personnel can be distinguished.

Categories of Laboratory Personnel

Several important categories of laboratory personnel may be distinguished in terms of their functions or in terms of differences in personal qualities, education or training. In one way or another the following categories may certainly be distinguished; some of them should, perhaps, be sub-divided further.

1. Directors of Research Establishments.
2. Directors of Research.
3. Research Scientists.
4. Maintenance Workers and Service Technicians.
5. Routine Scientific Workers or Laboratory Assistants.

Terminology is by no means completely uniform from one organization to another and the actual categories used are partly a matter of local administrative practice. There is clearly a need for precise definition, excellent examples of which are to be found in the recent Fleck Report (1957). This includes an appendix giving most comprehensive definitions of 'a scientist', 'a technologist', and 'a technician', as these terms apply to the Industrial Division of the Atomic Energy Authority.

It will not be possible to attempt to make a comprehensive appraisal of current views about all the categories given above and the special personal qualities involved. What follows is based largely upon personal opinion which has taken into account the published comments of a number of authorities not all of whom are mentioned specifically. Most of the discussions will be devoted to the research scientist and the routine scientific worker, although a few comments may be made about other categories. In categorizing people there is the common danger of assuming that distinguishing patterns of personal qualities characteristic of *groups* of persons necessarily characterize the individuals composing that group. For example, it is unlikely that there is any single 'model' for *The Scientist* although it may be possible to differentiate between groups of scientists and groups of non-scientists, or even between groups of different scientists. Unless we adopt the Earl of Halsbury's recent suggestions that individuals should be described in terms reminiscent of the language of North American Indians, normal practice in the use of our own language forces us to employ clearly differentiated categories. (*See* review in 'Nature' of a paper by Halsbury (1958) entitled 'Management, Group Conflict and the Sciences'). Over-simplified mental categories are referred to by psychologists as 'stereotypes' and, as indicated below, comparative freedom from stereotyped thinking is one characteristic which seems to differentiate between the most from the least creative of scientists.

(*a*) *The Scientist.*—A number of interesting opinions about the qualities looked for in research scientists primarily in industrial research establishments were expressed at a Conference held in 1951 at Columbia University. The views expressed at this Conference formed the substance of the editorial comment (1952) in 'Nature'. The information given below comes from this secondary source. Different contributors stressed the importance of different groups of qualities along the following lines:

1. Originality and creativeness.
2. Capacity to learn, subject to a certain basic minimum knowledge already acquired.
3. Character, scientific curiosity, practical outlook, initiative and energy, and a capacity for clear expression.
4. Ability to handle logically the organization of reproducible knowledge, ability to perceive the relevance of data and to test hypotheses in an unbiassed manner.

Two papers in the recent N.P.L. Symposium on the Direction of Research Establishments dealt with rather more objective information in the sense that it had been collected deliberately and by special techniques rather than having been based exclusively on individual personal experience. Thus Stein (1957) summarized a recent survey of factors affecting the creativity of (American) industrial research chemists. The author was very careful to point out the possibilities of differences between the 'culture pattern' in the two countries which might result in his data not being completely relevant to persons in the United Kingdom. However, the main purpose of the Symposium was to stimulate discussion on important subjects about which opinions are likely to be far from universal and existing knowledge is far from in a final state. The general approach in this and in the next paper to be summarized here was to contrast certain tabulated characteristics of the least creative and the most creative members of specific groups of scientists. The study by Stein included 23 persons in each group. As is commonly found, when the two groups were contrasted in this way, only a few 'significant differences' emerged. From these it was inferred that the more creative group were:

. . . less close to their fathers;
. . . less inclined to participate in group activities;
. . . less 'authoritarian' in outlook;
. . . less inclined to stereotyped thinking;

than the less creative group.

van Lennep (1957) reported upon 'Personality and

social factors related to creativity'. The work reported was originally undertaken to assist in assigning scientific personnel to the available positions in a particular research organization. It was suggested that 'Need for achievement', 'Problem solving ability', and 'Creativity' were three important qualities. These must be defined a little more fully. 'Need for achievement' was taken to refer to certain personal qualities by virtue of which an individual will show great persistence in the systematic use of orthodox techniques to solve a problem already posed and will not abandon such a problem until it has been solved. 'Problem solving ability' referred to the use of original and unorthodox methods to solve problems already formulated by management. This ability was presumed to be characteristic of swift and flexible thinkers who are able to survey all the available data at a glance. 'Creativity' referred to those qualities which enable the individual to give form and substance to a problem and to reformulate and solve it in an original way. The appropriate quantitative data were not reported in the synopsis of this paper, however van Lennep summed up the main differences between the more creative and the less creative groups of physicists and chemists as follows. The more creative group:

. . . were less dependent upon their immediate environment;

. . . were less rigid and dogmatic;

. . . had a particular type of time-perspective in which they saw the future not simply as a mere repetition of the past, nor as completely independent of their own actions, but as offering certain possibilities which they themselves might help to bring about.

(*b*) *The Routine Scientific Worker*.—The phrase 'the routine scientific worker' is taken from Myers (1941). This category might equally well be referred to as 'the laboratory assistant'. It seems necessary to differentiate between this group and 'the technician' who tends primarily to be a service or maintenance man. Obviously there must be a gradual transition of functions performed by these two groups ranging from the routine collection of data to the design and construction of new equipment such as might well come within the scope of some technicians' work. 'The Fleck Report' does not include a definition of 'laboratory assistant' but that no doubt was because the report was not primarily concerned with matters relating to this grade. In the paper referred to already, Myers mentioned both these groups and certainly distinguished between them. Of the routine scientific workers he suggested that they should not have too high intelligence or creative ability. They should be able to automatize their work and so detach their minds from it. The more extraverted could then engage in conversation while the more introverted could engage in pleasant thoughts. Persons in this group should be placid, steady and patient, and Myers was of the opinion that satisfactory tests for selecting this group could be developed. The emphasis placed on a specific attitude of mind characteristic of this group has been noted by a number of workers. However, a measure of caution is required in interpreting facts of this type, for qualities which seem to characterize certain groups and differentiate them from others may be the by-product of special training and experience rather than representing innate and unchangeable personal qualities. It may be noted here that Scott Blair and Coppen (1940, p. 75) observed, incidentally, that experience in routine laboratory work often makes it possible for the 'routine analyst' to acquire superiority over most other groups in the ability to make fine-grade discriminating judgments, quite unrelated to their usual work, over a long period of time. The members of this group are less likely than others to allow themselves to be affected by boredom or by doubts about the value of the tests they may be required to carry out.

Obviously a substantial proportion of the laboratory assistant group are young women whose interest may be maintained for a limited period, which is liable to end with marriage. However, it seems reasonable to suggest here that a proportion of this group might be capable of higher levels of creative and scientific work. Two related factors work against the effective use of any such hidden talent. The lack of essential background qualifications may prevent some of them from advancing further. The pre-suffragette-era belief that women cannot possibly be as good as men in matters of science and technology dies hard even if it is completely without sound logical foundation. This tends to perpetuate existing educational biases against a sound scientific education for girls and does not engender that basic interest required to set their minds working on the possibility of science as a career. However, the possibility should be recognized that routine scientific work might become a high-grade blind-alley even for young men, who may have greater intelligence than the highest grade of work normally carried out by laboratory assistants demands. This point merits further examination for it might be one contributory factor to the high labour-turnover which is known to exist in at least one scientific organization where about one-fifth of the assistant grade leave annually.

(*c*) *The Technician*.—Let us conclude this section with a short paragraph on the service worker or technician. Although this must be a particularly varied group to describe, Myers (1941) expressed the following views about its members. He suggested that they are likely to be better suited to implementing research results than to obtaining them. They are likely to be more extraverted than the routine scientific workers. They must be flexible, form human contacts quickly and give their knowledge a practical bent. Only moderate scholastic achievements are required and general industrial experience, rapid judgment, with accurate speedy work are likely to be more important than high intelligence. A certain measure of self-assertiveness and qualities of leadership are also desirable.

Selection and Training Problems

Once genuine differences have been established between individuals and types, the twin problems of selection

and training arises. One of the best critical appraisals of the methodology of systematic selection is given in an article by Haire (1950). No development of these techniques is possible unless there are established acceptable 'criteria of success'. These criteria have to be developed in the light of intimate knowledge of the particular work concerned. Systematic selection techniques also demand that there shall be a pool of applicants some of whom shall be selected and others rejected. This condition is rarely satisfied nowadays and it is therefore not surprising that there should have been an upsurge of interest in recent years in the problems of training, with a comparative decline in emphasis upon *new* developments in selection techniques. The relation between selection and training is somewhat complicated for whereas training seeks deliberately to modify the individual, systematic selection techniques employ information about the individual as he is to give a reasonable indication of what he may be expected to become. At the same time, performance during training may offer a valuable indication of occupational success and is often one of the principal, short-term criteria which is readily accepted. The value of systematic selection techniques is not to be judged in terms of perfectionist standards for there is no reason to believe that other, pre-existing methods achieve perfection. The main question is whether or not systematic techniques produce a reduction in the proportion of misclassifications or misfits. The value of systematic selection techniques is thus primarily actuarial in nature. Few, if any, professional psychologists would claim that systematic selection techniques provide *all* the information necessary for selection purposes. Equally, however, no one who has dispassionately examined the evidence can deny the useful contribution made by these techniques, provided they are employed correctly in an intelligent and informed manner. To be realistic, there are likely to remain many occasions when it is essential to make the best use of available personnel even if some of them do not match up perfectly to the requirements of the particular job. However the most sensible approach is to adjust the qualities determining the choice of an individual *and* the demands of the job so as to correspond to the greatest possible degree. Systematic selection techniques demand a catalogue of the characteristics of the person to be selected and the requirements of the particular job in strictly parallel terms. Quantitative information about the requirements for a particular type of job can then be built into tables of 'norms' or occupational reference standards. These function on precisely the same principles as the age-weight-height data which may be used to identify 'bad bets' in the strictly actuarial sense.

NOTE.—References to this and the preceding section will follow at the end of Article VII.

(To be continued)

D.S.I.R. Takes Over Tropical Products Institute

The Tropical Products Institute is to become one of the research stations of the Department of Scientific and Industrial Research. This follows the decision to transfer the responsibility for the Tropical Products Institute from the Secretary of State for the Colonies to the Lord President of the Council with effect from April 1, 1959.

The basic reason for this development is to be found in the changing shape and nature of the Commonwealth. Countries which have recently achieved independence, and thus no longer come within the scope of the Colonial Office, may still wish to avail themselves of the services of the Institute. In these circumstances it is more appropriate that the Institute should come under the control of the Department of Scientific and Industrial Research, whose Minister, the Lord President, has wider responsibilities for research in the civilian field.

Support will continue to be provided to the Institute by the Colonial Office, from the Colonial Development and Welfare Funds, for work of primary interest to, and benefit to the Colonies.

The main objective of the Tropical Products Institute will continue to be that of improving the economic viability of the under-developed territories of the tropics, primarily those that form part of the Commonwealth. The aim is to improve the technology of industries that already exist and to introduce new industries as a result of research into new uses for tropical plant and animal products (including waste products of existing industries). Particular attention will be directed to the needs for diversification in those territories which have a one crop economy.

The Tropical Products Institute has its roots in two bodies which were created independently—the Plant and Animal Products Department of the Imperial Institute and the Colonial Products Research Council. The work of the two bodies was combined under a single Director in 1953 and in December 1957 the laboratories were moved from the Imperial Institute to new premises in Gray's Inn Road. Simultaneously, the organization and its building took on the new name of 'The Tropical Products Institute' in anticipation of the broadening of its function in assisting under-developed countries that were not necessarily Colonies. The new Institute was opened by His Royal Highness the Duke of Edinburgh on May 6, 1958.

Royal Society's Tercentenary

The Royal Society is to celebrate its tercentenary in July 1960. For the purpose of the celebrations, the foundation date is taken to be November 28, 1660, when a meeting was held in the rooms of Lawrence Rooke, Professor of Geometry at Gresham College, and it was decided to found a society of experimental philosophy. The Journal book dates back to December 5, 1660, when Sir Robert Moray 'brought in word from the Court, that the King has been acquainted with the design of the Meeting. And he did well approve of it, and would be ready to give encouragement to it'. The title of the Society was then the Philosophers' Society and the name 'Royal Society' seems to have been coined by John Evelyn and first found its way into print in November 1660. Charles II granted the society a royal charter on July 15, 1662, and to quote Sir Henry Lyons' authoritative history ('The Royal Society 1660-1940: A History of its Administration under its Charters') that date 'has therefore been taken as the date of the foundation of the Royal Society'.

FOOD ANALYSIS-TECHNIQUES, INTERPRETATION AND LEGAL ASPECTS

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PART XI—TRACE ELEMENTS IN FOOD (Continued)

Summary

The analytical methods which may be employed for determining the six 'toxic' trace elements for which limits have been prescribed or recommended are discussed. References to suitable routine and reference methods for each element are given on page 92. The article concludes with suggestions for the reporting of results.

Arsenic

For the destruction of organic matter preparatory to the estimation of arsenic it is preferable in the writer's view to carry out a sulphuric-nitric acid wet oxidation. It is particularly important, however, when estimating arsenic to add the additional quantities of nitric acid *immediately* the liquid darkens and to follow this up by heating with ammonium oxalate solution until *copious* white fumes of sulphuric acid appear. The latter treatment breaks down residual nitrogen compounds which would otherwise retard the reduction which is necessary in the subsequent process. Alternatively if the amount of salt present is low, the less cumbersome Kjeldahl-type digestion appears to be satisfactory (Williams, 1941). For dry ashing it is necessary to use an abundant excess of magnesium nitrate as ash-aid (Allcroft and Green, 1935).

As a sorting test the Gutzeit method is often applied directly to the wet oxidized solution but for more exact work it is advisable to remove interfering substances by distillation (S.P.A., 1930) or by complexing with thiocomponds (Strafford *et al.*, 1945). In the S.P.A. (1930) method the arsenic is converted to the trichloride which is more volatile than the chlorides of other metals. The distillation is carried out in an all-glass apparatus into dilute nitric acid which re-oxidizes the arsenic and prevents losses during the subsequent evaporation. With foodstuffs the amount of arsenic present in the prepared solution is small and must be measured by a colorimetric method, as titration with iodate is insufficiently sensitive.

In the *Gutzeit method* for the estimation of arsenic the element is reduced to arsine by nascent hydrogen (using zinc and mineral acid or by electrolysis). The arsine forms a yellow to brown stain on a mercuric chloride (B.P.) or bromide (A.O.A.C.) paper according to the amount of arsenic present. The colour is compared with standard stains produced under the same conditions. The Gutzeit method can be applied 'direct' to solutions of chemicals which dissolve in water or acid (e.g. B.P. 1958) and also to liquids such as beer and vinegar, i.e. without carrying out an ashing procedure. The many modifications which have been suggested to the original Gutzeit technique, e.g. the more efficient production of the arsine when the zinc used contains a small proportion of copper, various electrolytic procedures, etc. are reviewed by Monier-Williams (1950, p. 174).

The most important *colorimetric method* for determining arsenic in the solution itself is the procedure usually attributed to Denigès in which the element forms with molybdate a compound which on reduction (usually with stannous chloride) produces a blue coloration quantitatively which can be measured visually or absorptiometrically against standards. The arsenic must be separated from phosphorus, which also gives the reaction, by distillation as chloride or by conversion to arsine followed by absorption of the gas in an oxidizing agent. Most of the modifications which have been suggested are included in Monier-Williams' (1950, p. 198) review in which the importance of careful standardization of reagents and conditions is stressed. More recently Eastoe and Eastoe (1953) have claimed improved colour stability using 1-amino-2-naphthol-4-sulphonic acid as reducing agent.

Copper

Prior to the determination of copper, dry ashing at 500-550°C. is satisfactory for the destruction of organic matter provided that certain precautions are taken. Low results are due to absorption of copper on etched dishes and to formation of insoluble compounds, but High (1947) has shown that, provided nitric acid as well as hydrochloric acid is employed for the extraction, good results are obtained even if the ashing temperature is as high as 800°C. It is advisable to use magnesium nitrate as ash-aid unless a bulky ash is expected. If wet oxidation is employed the material should be heated first with nitric acid to remove chloride before adding the sulphuric acid.

Numerous *colorimetric* reagents may be employed for the determination of copper (Monier-Williams, 1950, p. 54; Polhill, 1956a). Formerly ferrocyanide was frequently used for sorting tests (*see* Lampitt *et al.*, 1926), but this has now been largely replaced by sodium diethyl-dithio-carbamate, which reacts with copper in *neutral or alkaline solution* to form a yellow-brown colloidal solution. When the carbamate reagent is employed iron can be removed by precipitation with

TABLE I

Trace elements in food
Statutory and recommended general limits and suggested methods of determination

Element	*Food Standards Committee recommended general limits calculated as the element in p.p.m.*			*Statutory limits calculated as the element in p.p.m.*	*Chemical methods of determination*	
	*Date of H.M.S.O. Publication or suitable reference**	*Most ready to drink beverages*	*Most other foods*		*Suggested routine or sorting method*	*Official or confirmatory method*
Arsenic	H.M.S.O. (1955)	0·1†	1†	Gelatine 2	Gutzeit method on wet oxidized material without distillation	Gutzeit method after S.P.A. (1930) distillation; alternatively Eastoe et al. (1953)
Copper	H.M.S.O. (1956) and Circular FSH 13/58	2†	20†	Gelatine 30 Tomato Ketchup 20	High (1947) or Forster (1953)	Abbott and Polhill (1954)
Lead	H.M.S.O. (1954)	0·2†	2†	Gelatine 7 Curry powder 20	Hamence (1932) for foods with limits ⩾ 5 p.p.m.	S.A.C. (1954)
Tin	Anal., 1953, **78**, 187; Fd.Tr.Rev., 1953, Feb., p. 14*	—	250 (applies to all canned foods)	—	A.O.A.C. (1955) — volumetric method omitting sulphide separation	Dickinson and Holt (1954)
Zinc	Anal., 1954, **79**, 244*	5	50	Gelatine 100	Sylvester et al. (1936) — thiosulphate titration	S.P.A. (1948)
Fluorine	H.M.S.O. (1957)	—	Acid phosphates ... 30 Baking powders 15 Self-raising flour, etc. 3	... ... 300 ... 100 or 133 8	S.P.A. (1944)	S.P.A. (1944, 1945)

*Where the official report appears to be now unobtainable a suitable reference is quoted
†There are numerous exceptions to the general limit quoted in the report

ammonia. The addition of citrate prevents the precipitation of phosphate and the presence of gum arabic brightens and stabilizes the colour (S.P.A., 1939; High, 1947). The effects of interfering ions are decreased considerably by extracting the copper diethyl-dithiocarbamate with either carbon tetrachloride (Haddock and Evers, 1932), amyl acetate (Stone, 1942), iso-amyl alcohol (Thatcher, 1933) or chloroform. Cheng and Bray (1953) prevent the interference due to metals by extracting the colour with carbon tetrachloride from a solution containing the di-sodium salt of EDTA buffered with citrate. Forster (1953) has proposed another method which employs the ammonium salt of EDTA.

Diethyl-dithio-carbamic acid is decomposed in acid solution. However, solutions of diethylammonium-diethyl-dithio-carbamate in chloroform (Wyatt, 1953) and of the zinc, potassium and dibenzyl-ammonium salts of dibenzyl-dithio-carbamic acid in carbon tetrachloride (Stone, Ettinger, and Gantz, 1953; Abbott and Polhill, 1954) extract the corresponding copper complex quantitatively from *acid solution*. Using these reagents interference from phosphate, iron, etc., is negligible and

the Abbott and Polhill (1954) method is suitable for determining copper in oils and fats over the range 0·02 to 2 p.p.m.

For further information relating to the determination of copper in foods reference should be made to Monier-Williams (1950, p. 38) and Polhill (1956a).

Lead

For substances which give colourless solutions in water, lead can be determined approximately by adding sodium sulphide to the alkaline citrate solution (containing cyanide to prevent interference from copper) and comparing the colour against standards. For most foods it is advisable to destroy organic matter either by dry ashing or wet oxidation. Although many analysts object strongly to the former method there is no real evidence that lead is lost by careful incineration at 450-500°C. (S.A.C., 1954; S.A.C., 1955; Hart, 1951; Gage, 1955, Tompsett, 1956). It is advisable, however, to use an ash-aid and to reserve a special furnace for the purpose. In view of the extremely low limits which have been recommended for some foods it is important to use 'lead-free' reagents for wet oxidation in order to keep blanks as low as possible.

The methods for separating and estimating lead have been reviewed by Monier-Williams (1938; 1950, p. 84), Sandell (1950) and Polhill (1956b). The reagents most commonly used for separating lead, are dithizone (Allport and Skrimshire, 1932), and various carbamates, especially diethylammonium-diethyldithiocarbamate (Hart, 1951; S.A.C., 1954; Lockwood, 1954). Alternatively by adding thiocyanate to the aqueous solution iron can be removed by extracting the ferric thiocyanate so produced with ether-amyl alcohol mixture (Hamence, 1932).

For the final estimation of lead the sulphide coloration (S.P.A., 1935) is still often used as a limit or sorting test, but it is unsuitable for foods for which low limits have been recommended. It is often necessary therefore to employ the more sensitive methods using dithizone, viz., mono and mixed colour methods, Irving's (1953) reversion technique and extractive titration methods (Lockwood, 1954)*. The S.A.C.'s (1954) tentative general method for the determination of lead in foodstuffs employs a mono-colour technique so that it can be employed in laboratories which do not possess an absorptiometer.

Polarographic methods for determining lead have been proposed by Jones and Brasher (1947) and Ferret, Milner, and Smales (1954).

Tin

Prior to the determination of tin the writer prefers to employ nitric-sulphuric wet oxidation for the destruction of organic matter. Formation of insoluble metastannate is seldom troublesome in practice (cf. Schryver, 1908), but if present this can be brought into solution by treatment with tartaric acid solution followed by neutralization with alkali (Allport and Skrimshire, 1932). If the nitric acid is omitted the digestion tends to be rather time-consuming. Insoluble tin oxide is formed during dry ashing, but the metal can be brought into solution by fusion with alkali.

The methods for estimating tin in foods have been reviewed by Monier-Williams (1950, p. 150). The tin can be conveniently estimated by the *volumetric method.* The wet oxidized material is treated with hydrochloric acid and chlorate and the tin is reduced in an inert atmosphere with aluminium and titrated with dilute standard iodine solution. The inert atmosphere can be maintained in the flask during the reduction by attaching a Contat-Gockel valve of the type suggested by Jackson (1953) containing potassium bicarbonate solution which drops into the acid solution when the pressure drops during cooling. Although there is a slight possibility of high results due to the presence of interfering metals the volumetric method is convenient for routine work, as modern canned foods usually give results well below the recommended limit of 250 p.p.m. For more exact work the tin can be separated by precipitation with hydrogen sulphide prior to the treatment with chlorate (A.O.A.C., 1955, p. 451).

The *colorimetric* reagent which is usually employed is dithiol (4 methyl-1:2 dimercapto-benzene), which gives a red precipitate with stannous tin. Thioglycollic acid is used to ensure that the tin is present in the divalent condition. In the earlier dithiol procedures the precipitate was kept in suspension by a colloid such as agar and the colour measured by reflected light in the Lovibond tintometer (Clark, 1936, 1937; de Giacomi, 1940). More recently Dickinson and Holt (1954) have developed a procedure in which the organic matter is destroyed by dry ashing followed by fusion with a carbonate-cyanide mixture. Teepol is used as stabilizer and the colour determined in an absorptiometer using transmitted light. However, the authors state that interference due to copper is more serious than with visual measurement and it is sometimes necessary to carry out a carbamate separation.

The *gravimetric method* in which the purified sulphide is ignited to oxide is rather insensitive for the small amounts of tin normally present in canned foods.

Polarographic procedures for tin have been proposed by Godar and Alexander (1946) and Markland and Shenton (1957).

Zinc

Dry ashing at 500-550°C. is suitable for the destruction of organic matter prior to the determination of zinc (Sylvester and Hughes, 1936). The S.P.A. (1948) recommends that the food is wet oxidized.

The nephelometric determination using potassium ferrocyanide in acid solution is useful as a sorting test for zinc. The opalescence reaches a maximum in about 10 minutes and the reagent should be added to the tube containing the standard zinc solution at the

*The principles of these methods have been discussed in the previous article.

same time as the test cylinder. The method is discussed by Fairhall and Richardson (1930) and Boggs and Alben (1936).

For *more precise routine work* the writer prefers the method of Sylvester and Hughes (1936) in which ammonium acetate is added to the solution of the ash in hydrochloric acid to produce a pH of 4·5 and various metals (Zn, Cu, Hg, Ag, Bi, and Cd) are extracted several times with dithizone in chloroform. The zinc (together with Bi and Cd) is then removed from the washed dithizone solution with N/2 hydrochloric acid and the acid aqueous extract evaporated to dryness. The residue is oxidized with perchloric acid and hydrogen peroxide and estimated by Lang's (1929) method, in which zinc in the presence of ferricyanide liberates from potassium iodide an equvalent amount of iodine which is then titrated with N/500 thiosulphate. Interference from iron is prevented by adding a trace of ammonium hydrogen fluoride. Lang's (1929) titration method is specific for zinc.

A *standard method* for the determination of zinc has been proposed by the S.P.A. (1948) in which the zinc (together with Pb, Cu, Ag, Cd, Hg, Ni, Co, and Bi) is extracted from the wet oxidized solution at pH 7·5-8·0 employing diethyl-ammonium-diethyl-dithio-carbamate in chloroform. The zinc is removed with alkaline-citrate solution and the carbamate destroyed with bromine water. The solution is then neutralized, buffered, at pH 8·7-9·3 with borax and the zinc determined by extractive titration using standardized dithizone solution (cf. Francis and Pilgrim, 1957).

Most of the methods which have been proposed for the determination of zinc in foods have been reviewed by Monier-Williams (1950, p. 120). A polarographic method has been described by Walkley (1942).

Fluorine

The S.P.A. (1944) described a modification of Willard and Winter's (1933) method which is suitable for determining fluorine in foods of the order of 5 p.p.m. or less. The material (usually either acid phosphate, baking powder or self-raising flour—see The Fluorine in Food Order, 1947) is ashed with specially prepared 'fluorine-free' lime at 600°C. and the fluorine steam distilled at 137-140°C. as hydrofluosilicic acid. Any chloride present is precipitated with silver sulphate so that no hydrochloric acid passes over into the distillate. Thorium nitrate solution is added to an aliquot of the distillate in a Nessler glass together with alizarin S and the lake so produced is bleached (made less pink) by the fluorine present. A control tube is also prepared containing water and this is brought to the same controlled acidity and similar amounts of thorium nitrate and alizarin S are added. This control tube is then 'back-titrated' with standard fluoride solution until the pink colour is reduced to the same intensity as the test glass.

In a further report the S.P.A. (1945) recommended that with materials consisting largely of phosphates the distillate should be neutralized and redistilled with perchloric acid. In the writer's view this additional procedure is unnecessary for routine work. Further, it appears that an ordinary distillation flask could be employed instead of the Claissen flask recommended by the S.P.A. (1944). Estill and Mosier (1955) have designed a semi-automatic apparatus suitable for distilling fluorine incorporating a thermostatically controlled heater, which assists in reducing the distillation time.

Other methods which have been proposed for the determination of fluorine are discussed by Monier-Williams (1950, p. 367) and Fryd (1956).

New glassware tends to produce high blanks in fluorine determinations and should therefore be treated before use with hot caustic alkali followed by acid.

General Methods

It is useful to have a scheme for routine work whereby a number of metals can be estimated in a food from the one prepared solution. Useful schemes of this nature have been presented by Hamence (1937), Scott-Dodd (1949) for gelatine, Strafford *et al.* (1945), and Abson and Lipscomb (1957).

Another simple general method which is suitable as a limit test for heavy metals in foods involves dissolving the ash in hot hydrochloric acid and then making the solution ammoniacal to precipitate the iron. The liquid is then filtered into a 50 ml. Nessler glass and the pH is adjusted to the bromphenol-blue neutral point with dilute acid and ammonia. Then hydrogen sulphide solution is added so that the sulphides of lead and copper produce the usual brown coloration, and that of zinc a turbidity. The brown coloration is compared with that obtained with a standard lead solution and represents the amount of 'heavy metals' (lead, copper, etc.) present. By complexing the copper by addition of cyanide any brown coloration is due to lead only.

Reporting the Results of Trace Element Determinations

The results of trace element determinations are compared with the legal and prescribed limits which vary from 0·1 to 300 p.p.m. The accuracy to which the result is reported is bound up with such limits and with the method of measurement, possible blanks, etc. It is difficult therefore to lay down hard and fast rules for the reporting of the results of trace element determinations, but suggestions are given in Table II.

Where the limit is very low the accuracy can be increased by carrying out the determination on a greater weight of original material. The minimum amount used for foods is 5 g. and it is quite accurate enough to weigh out the material carefully on a *good* rough balance. Thus if an error of 0·1 g. is made in weighing 10 g. of food (a bigger error than is likely with modern rough balances) this will only produce an error of 0·1 p.p.m. in a result of the order of 10 p.p.m. A result of this order would not be reported to a greater degree of accuracy than the nearest whole number. Similarly a result of the order of 100 p.p.m. would be inaccurate due to such a weighing error to the extent of

TABLE II

Suggested rules for the accuracy to which trace element determinations should be reported

Legal or recommended limit (p.p.m.)	*Accuracy to which the result should be reported (p.p.m.)*
	To nearest or* next lowest multiple of:
⩽ 0·2	0·05
0·2—2·0	0·1 (first place of decimals)
2—20	A whole number
20—100	5
above 100	10

*It is usually expedient to report a figure which is slightly lower than that actually calculated from the determination (*see* Pearson, 1958).

1 p.p.m., but it is not usual to report the result more accurately than to a multiple of 5 or 10. From these examples it is obvious that there is little to be gained by spending time weighing out foodstuffs for trace element determinations on a very accurate analytical balance.

The results of *limit tests*, e.g. heavy metals (*see* above), comparison with a standard Gutzeit stain or a Nessleriser disc, can simply be reported as '<Y p.p.m.,' where Y may be the legal or recommended limit.

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FOOD LEGISLATION—AMENDMENTS AND ADDITIONS

Since the publication of Part III in the Food Analysis series a few changes in the law relating to food have been made. The list of regulations given in *Laboratory Practice*, January 1958, p. 25-26 should therefore be amended as follows:

No. 32. The Public Health (Preservatives, etc. in Food) Regulations.
Additional amendments—S.I. 1958, No. 1319 and S.I. 1958, No. 2167.

No. 32A The Antioxidant in Food Regulations, 1958—S.I. 1958, No. 1454.

No. 34. The Labelling of Food Order.
Additional amendment—S.I.1958, No. 717.

No. 35. The Food Hygiene Regulations.
Additional amendment—S.I. 1957, No. 2157.

No. 37. Previous regulations are replaced by: The Pre-Packed Food (Weights and Measures: Marking) Regulations, 1957—S.I. 1957, No. 1880.

N.B. Butterworth & Co. Ltd. have recently published a 'Service Volume' to Bell's Sale of Food and Drugs (by J. A. O'Keefe).

Royal Society Appointments

The President of the Royal Society, Sir Cyril Hinshelwood, has appointed the following Vice-Presidents for the year ending November 30, 1959:

Sir William Penney, K.B.E., Treasurer of the Royal Society, director of the Atomic Weapons Research Establishment, Aldermaston.

Sir Lindor Brown, C.B.E., Biological Secretary of the Royal Society, Jodrell professor of physiology at University College, London.

Prof. W. V. D. Hodge, Physical Secretary of the Royal Society, Lowndean professor of astronomy and geometry in the University of Cambridge.

Sir Charles Dodds, M.V.O., Courtauld professor of biochemistry in the University of London.

EXHIBITION OF LABORATORY APPARATUS

The Bristol and District section of the Royal Institute of Chemistry is to hold an Exhibition of Laboratory Apparatus at the College of Technology (Davy House), Ashley Down Road, Bristol, from April 1 to 3 inclusive.

COLLOQUIUM FOR EXPERIMENTAL GLASSBLOWERS

ON December 3, 1958, the Ministry of Supply held in London their eighth one-day Colloquium for Experimental Glassblowers. The programme was as follows:

'Talk and Discussion'.

'Silica Working', Messrs. M. Lawther and C. Underwood of the Thermal Syndicate Ltd., introduced by Mr. T. P. Browell.

'Cutting glass by Diamond', Mr. P. R. Ord, lately of Kodak Ltd.

'Ultrasonic Machining of Glass', Mr. G. E. Littleford of Kerrys (Ultrasonics) Ltd.

Silica Working

Mr. T. P. Browell, a technical representative of the Thermal Syndicate, in a brief introduction outlined the major differences between fused silica and other glasses used for lampworking. Mr. Lawther then spoke, and explained that he and Mr. Underwood were chiefly concerned with the blowpipe working of fused silica. They would endeavour to pass on to the meeting some of their experiences gained in the working of the material, and they hoped that it would prove useful. Mr. Lawther divided his talk into sections devoting a few minutes to the description of the techniques to be used in each case. When joining larger diameters of heavy wall translucent tubing a welding technique must be used. The ends of the tubes to be joined are carefully chamfered off so that the thinned portion is on the inside of the join. The tubes are joined together and the V-shaped groove all round the circumference is carefully filled in with softened silica rod. Small filling is used to fill in the sharp inner edges, and then larger filling to fill up the remainder of the groove. When tubes are to be joined in the form of a T great care must be taken to ensure that the two portions are cut and chamfered to a good fit, with the thinned edge on the inside before any welding is attempted. The parts should be carefully preheated, and when welding is completed, annealed either by manipulation of the flame or in a suitable furnace. Where possible blowing of joints is to be preferred, particularly with transparent fused silica.

In all cases absolute cleanliness is essential; degreasing, cleaning in 40 per cent hydrofluoric acid, washing in clean water and rinsing in distilled water, must always be carried out before heating with the blowpipe. Any finger marks must be removed before heating. Transparent fused silica can be shaped by using graphite tools and formers, or formers made of some refractory metals. Tubing of accurate internal dimensions and of cross sections other than circular may also be produced. Ground joints both cones and sockets can be produced by vacuum shaping or other methods. Mr. Lawther also mentioned molybdenum seals and graded glass to fused silica seals.

Protective spectacles must be worn when working fused silica, because of the intense radiation given off. The glasses supplied by Safety Products Ltd. of Redhill, Surrey, are used by the Thermal Syndicate; these glasses are made in various shades, shades G.W.4 being suitable for general work. A useful spectacle is where either the upper or lower segment is plain glass for direct vision and the complementary segment is made up of dark glass. Good ventilation is necessary if much silica working is to be carried out, and in the Thermal Syndicate's works a system of trunking and cowls is used. Mr. Underwood confined his talk mostly to the working of the transparent form of fused silica; he reiterated Mr. Lawther's remarks about the necessity for absolute cleanliness, and then went on to describe and exhibit various blowpipes that he used for silica working. A very relevant point he made was the adjustment of the flame for each particular job. This is largely a matter of experience and has to be decided by the operator on the job, but it is important to remember that a surplus of heat is more desirable than insufficient heat. Therefore it is better to use the largest possible jet size suitable to the work to be carried out. This ensures a good fusing together of the material and reduces the amount of haze gathered round the joint. The adjustment of the flame is very important, the ideal flame shows a cone of about ¼ in. to ⅜ in. of light blue, excess of oxygen in the mixture gives a dark blue flame and a loss of heat. While he did use oxy-hydrogen flames he preferred oxy-pyro (propane) flames; with them there was less tendency to blow the silica away. Mr. Underwood dealt with the methods to be used in the sealing up of flame cracks in silica should they occur. He also passed round some examples of joins in transparent silica to illustrate good and bad techniques. Using the correct methods it was possible to join two tubes together so that the join was almost invisible. A bad join exhibiting a line of scum or small bubbles was due to the ends of the tubes not being cleaned in hydrofluoric acid before joining. A very lively discussion then took place with Mr. Lawther and Mr. Underwood answering many questions. The success of their talks may be judged from the fact that there was still a large discussion group carrying on long after the meeting had officially adjourned for lunch.

Cutting Glass by Diamond

Mr. Ord prefaced his talk by explaining that his work on the cutting of glass by diamond had been concerned with the mechanical cutting of sheet glass in large quantities for photographic plates. When these plates reached the cutting stage in the factory a good deal of work had been carried out on them. They had been coated with emulsion and also backed, so it was very important that the percentage of failures in the cutting operation should be kept low.

The manufacturers of glass cutting diamonds had found by long experience that if the diamonds were to

be used for hand cutting of glass the optimum angle of the diamond faces, the ridge angle, has to be 125 to 130°. Although Preston (1921-22) had already described the nature of the cut made by the hand operated diamond, and Dalladay and Twyman (1921-22) have described the stress system round such a cut, very little fundamental work had been done to try and discover why this angle of 130° was necessary. When cutting glass by hand the glazier finds the correct diamond to glass angle by trial and error, when this angle is found and the diamond drawn across the glass a distinct note is heard, the diamond 'sings'. The whole time the diamond is passing across the glass this angle must be maintained, and a glazier's skill lies in his ability to maintain this position to a high degree of accuracy throughout the cutting stroke. The fundamental requirement for cutting glass is the production of a vertical fissure in the glass. The main obstacle to securing a clean cut is the formation of more or less horizontal cracks, which leads to splintering and sometimes even prevents the formation of a vertical fissure. Experimental work had shown that the ridge angle of 125-130° of the diamond ensured the easiest and most satisfactory control of the cutting angle. Greater ridge angles, such as 140°, made the cutting angle more critical and therefore harder to maintain, while angles of less than 125° are extremely sensitive to lateral motion of the diamond while cutting. If mechanical cutting is used and these two angular positions (vertical and lateral) of the diamond can be very accurately controlled, then the established figure of 125-130° for the ridge angle becomes obsolete and a certain freedom of choice becomes possible.

Mr. Ord then described a cutting machine which had been developed, using a 'brilliant' with a ridge angle of 90° as the cutter. He showed by means of photomicrographs and diagrams how this machine produced a perfect cut at a fast cutting speed with a complete absence of splinters.

Ultrasonic Machining of Glass

Mr. Littleford prefaced his talk by remarking on the misunderstanding or confusion created in some people's minds by the use of the word *ultrasonic* drilling or machining. The method could perhaps be called more correctly *impact grinding*, for the drilling or cutting action is carried out by an abrasive material placed between the vibrating tip of the drill and the workpiece. Machining by a high frequency reciprocating device of this sort is essentially a chipping action, and although the particles of material removed are very small the action is so rapid that a high speed wearing can always be obtained if the material to be worked is sufficiently brittle. The method is indeed only useful for hard, brittle materials, and is not suitable for soft, or tough substances.

Mr. Littleford then described the type of machine used for this purpose. A conventional oscillator and amplifier combination is used to drive the vibrating part of the machine, the transducer. In practice any of the three common types of transducer, piezoelectric, magnetostrictive or electrostrictive can be used but on the whole magnetostrictors are to be preferred. They are simpler to construct and operate at suitable frequencies and can be designed to withstand larger strains. To obtain the maximum possible drilling rates the tool must be made to move with as large an oscillatory amplitude as possible, the velocity at the tip being much less important than the displacement. This means that a low operating frequency is an advantage, since the lower the frequency the lower the input power required to produce the same amplitude. From the point of view of convenience in operation there is an obvious advantage in keeping the frequency ultrasonic, so that the most efficient practical vibrator is a magnetostriction transducer resonant at a frequency just above the audible limit, 20 Kc/s. At this low frequency nickel is the most suitable material, and the transducer is made up of laminations of this material. Using about 60 watts electrical drive power, a peak to peak oscillatory amplitude of 0·0005 in. can be obtained at the transducer face. By the use of a step up velocity transformer, which is a tapered or stepped stub of metal, attached firmly to the transducer face, the amplitude may be increased to 0·002 in. As an example of the cutting rates obtainable, a square hole of about $\frac{1}{4}$ in. side may be drilled $\frac{1}{4}$ in. deep in about one minute in glass or ceramic using a carborundum abrasive. In tungsten carbide, using boron carbide as the cutting agent the corresponding time would be about 10 minutes. Since the amplitude of the reciprocating motion is small, curved holes may be obtained by using a tool bent in the arc of a circle. In a similar manner a bent tool may be used for lapping a glass tube internally, and even for screw cutting in glass. At the conclusion of his talk Mr. Littleford answered many questions, and also showed a film entitled 'Ultrasonics'.—J. A. FROST.

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G.E.C. Chief Chemist's Nomination

Mr. R. C. Chirnside, F.R.I.C., Chief Chemist of the Research Laboratories of The General Electric Company Ltd., Wembley, has been nominated by the Council of the Society for Analytical Chemistry as President designate to take office at the Annual General Meeting in March.

Mr. Chirnside, who is 55, has been a member of the Council of the Society on a number of occasions since 1938 and was a Vice-President in 1946-7, 1951-2 and 1957-8. He has also been a member of the Council of the Royal Institute of Chemistry on a number of occasions since 1944 and was a Vice-President from 1956 to 1958. He has taken a prominent part in the activities of the International Union of Pure and Applied Chemistry, and was Honorary Secretary of the International Congress held under the Union patronage at Oxford in 1952.

Mr. Chirnside is also a member of the British National Committee for Chemistry, a Governor of Brunel College of Technology, a member of the Advisory Committee for Chemistry of the Chelsea College of Technology, and a member of the Board of Studies in Chemical Engineering of London University.

A SIMPLE AUTOMATIC β-COUNTER FOR SOLID SAMPLES OF LOW ACTIVITY

by G. E. Eden and K. V. Melbourne

Water Pollution Research Laboratory, Stevenage

THE accepted method of monitoring water for low levels of radioactive contamination is to evaporate a suitable volume to dryness and then to measure the activity of the residue. In the case of β-activity a thin-end-window G.M. tube, or a windowless gas-flow counter, is used, and the results are expressed in terms of the isotope, usually Sr 90, Tl 204, or K 40, with which the counter has been calibrated.

The precision of the determination is governed mainly by the number of counts recorded; thus the standard deviation of an observation of N counts is $\pm\sqrt{N}$. Expressed as a percentage this is $\pm\frac{100\sqrt{N}}{N}$ or $\pm\frac{100}{\sqrt{N}}$, that is, the precision is increased by observing larger numbers of counts.

The ultimate sensitivity of the method may be conveniently expressed by considering the standard deviation of the result obtained when the counting rate of the sample plus background is apparently equal to the background counting rate alone. If the result then is $0 \pm a$ μμc per litre it may be shown that $a = \frac{64}{EV}\sqrt{\frac{B}{T}}$

where E is the percentage efficiency of the counter (counts per 100 disintegrations in the sample)
V is the volume of sample (litres)
B is the background counting rate (counts per minute)
T is the period of counting (min.) either for background alone or for sample plus background.

For a commonly-used G.M. tube (G.E.C. type 2B2)
E = 30 for hard β-emitters
B = 30 when shielded with 2 in. of lead
V = 2 (say)

$$\text{Hence } a \approx \sqrt{\frac{30}{T}} \text{ or } T \approx \frac{30}{a^2}$$

The level of natural β-activity in waters may be equivalent to as little as 1 μμc/l. (This is usually due largely to the radioactive isotope K 40 of natural potassium.) If therefore we wish to measure this activity with a standard deviation of ± 0·3 μμc/l., the counting time T = 333 min. The number of background counts in this time will be 333 × 30 or about 10,000.

If the counter is operated manually only a few samples can be handled in a working day and it is desirable therefore, when many samples are to be examined, to use a counter in which changing of samples and recording of results are effected automatically. Such counters are available commercially. However, it is possible to design, for the present purpose, a counter which, although lacking the flexibility of the commercial counters, is comparatively cheap and is capable of providing the essential facilities.

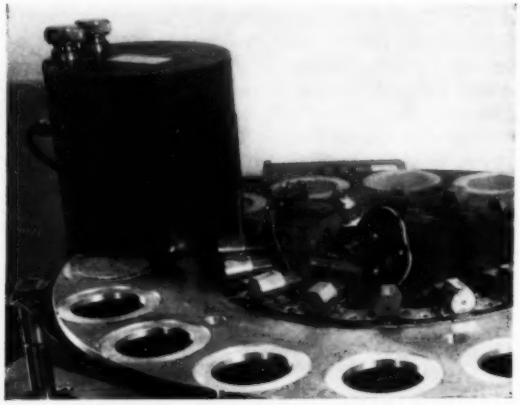


Fig. 1. Lead castle, sample changer, and timing device of automatic counter.

Basically the counter consists of a lead castle surrounding the G.M. tube, a turntable mechanism for presenting samples to the counter, a commercial scaling

Fig. 2. General view of automatic counter. The instrument rack on the right contains, from top to bottom, the L.T. and H.T. supply unit, the relay unit, the scaler, and the E.H.T. supply unit.

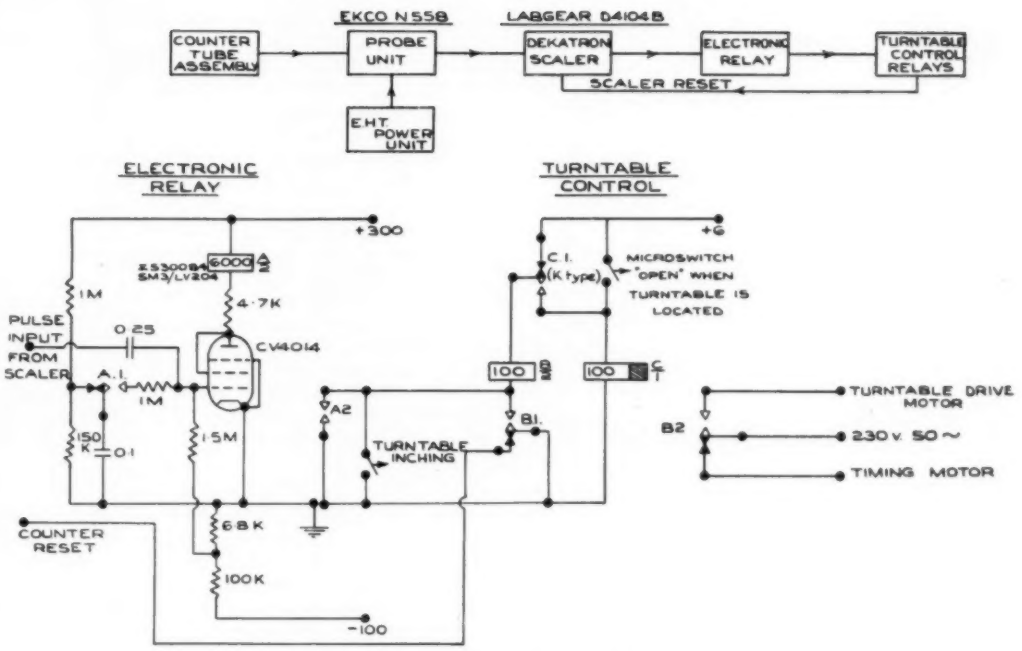


Fig. 3. Circuit for control of turntable.

unit and power supply units, and a relay unit controlling the turntable. The castle and turntable are shown in Fig. 1 and a general view of the complete apparatus in Fig. 2.

The principle of operation is that each sample is retained under the counter for sufficient time for a selected number of counts, say 3,000 or 10,000, to be accumulated in the scaling unit. The time is recorded on a revolution counter mounted on the turntable near the sample, and which, for the duration of the counting period, is connected to a shaft driven at 10 r.p.m. by a synchronous motor. When the required number of counts has been accumulated, a pulse from the scaler switches off the timing motor, holds the scaler in the 'reset' condition, and starts a second motor which drives the turntable to the next position. When the next sample is in position a micro-switch is operated which switches off the driving motor, starts the timing motor, and restores the scaler to the 'count' condition. The same sequence is repeated for each sample. A peg is provided which, when inserted in one of a number of holes on the turntable, will switch off the whole apparatus when the turntable reaches a certain position. The same circuit switches off the apparatus in the event of a momentary power failure.

The turntable, of light alloy, has an external diameter of 21 in. and an internal diameter of 9 in. Circular recesses are machined to receive 16 counting trays, each of which is 3 in. in outside diameter and is press-formed from 1/32 in. aluminium sheet, to give a central depression 2 in. in diameter and $\frac{1}{16}$ in. deep. Mounted on the inner rim of the turntable adjoining each recess is a simple revolution counter. Notches are machined in the outer rim to engage a micro-switch whenever a tray is centred under the counter. Holes for the moveable peg are provided between the revolution counters. The turntable is supported at three equidistant points, two of which are ball-races mounted on pillars; the third is a knurled wheel $1\frac{3}{4}$ in. in diameter which may be driven at about 1 r.p.m. by a synchronous motor to rotate the turntable. Lateral movement of the turntable is prevented by three ball-races bearing on the inner ring of the turntable.

The counter tube is mounted within a lead castle having a height of 8 in. and a diameter of 6 in.; the inner cavity, 2 in. diameter $\times$ 4 in. deep, is therefore shielded on all sides by 2 in. of lead. Usually a large end-window counter (G.E.C. type 2B2) is employed but when necessary a smaller tube (G.E.C. type EHM2) may be fitted instead. To accommodate the smaller counting trays used with the latter tube, adaptors are fitted in place of the large counting trays, and the small counting trays are placed on the adaptors. A satisfactory adaptor consists of an empty small tray cemented centrally on a large tray.

The timer motor is mounted within the inner rim of the turntable as shown and drives through a suitable gearbox a metal finger which engages a pin on the shaft of the revolution counters. These are fitted with eccentric weights so that when not engaged the pin falls

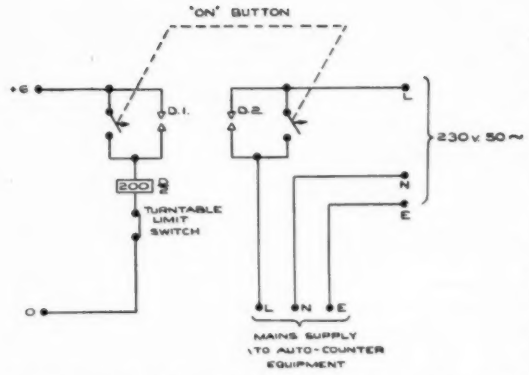


Fig. 4. Circuit for switching off apparatus on operation of limit switch or on failure of the mains supply.

to its lowest position. The micro-switch to engage the moveable peg is mounted on the gearbox.

The arrangement of the main components is shown in block form in Fig. 3, together with a diagram of the turntable control circuit. The scaler used is of a commercial type (Labgear type 4104/B) modified by the makers to give an output pulse at the completion of 1,000, 3,000, 5,000, 10,000, or 100,000 counts, and further modified in the laboratory by substitution of a 0·5 μF. condenser in the 'pulse out' circuit and a co-axial socket in series with the reset switch.

The relay circuit operated by the turntable limit switch when actuated by the peg on the turntable is shown in Fig. 4. This and the turntable control circuit are mounted on a simple chassis shown above the scaler unit in Fig. 2, An 'inching' switch is provided for rotating the turntable to any desired position, together with a biased switch for resetting the limit switch circuit.

The same principle of operation may be embodied in instruments using other forms of counter. For example, in counting samples containing β-emitters of low energy it is possible to increase the efficiency E by substituting for the G.M. counter a windowless gas-flow counter. It is also possible by using an anti-coincidence counting arrangement, to reduce considerably the background counting rate B. In this latter case the greater bulk of shielding necessitates some modification of the method of timing. Such a counter is at present under construction.

ACKNOWLEDGMENTS.—*The mechanical parts of the apparatus were constructed in the workshops of the Water Pollution Research Laboratory by Mr. E. A. Irving; the relay device was developed and made by Mr. F. S. Davies. The work for which the apparatus was designed forms part of the programme of the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research, and the paper is published by permission of the Department.*

A SIMPLE PROCEDURE FOR CALIBRATING WARBURG MICRORESPIROMETERS

by E. A. Hook, C. C. Morris, and R. D. Batt

University of Otago Medical School, Dunedin, New Zealand

MANY methods have been described for calibrating Warburg manometers, of which the most accurate procedures use mercury to determine the exact volume of the flask and manometer to the zero mark (X on the diagrams). In referring to mercury calibration Umbreit *et al.* (1949) stated that although the method 'may appear more laborious than other methods, it is the most accurate method available and is not particularly time consuming after one has had a little practice'.

It is desirable that biochemistry students during their undergraduate course should become familiar with Warburg manometric techniques and there is no better introduction to the procedures for emphasizing the sensitivity and accuracy of the method than by calibrating, accurately, at least one manometer. With this view in mind it became desirable to simplify the accepted procedures for calibration (with no loss in accuracy) so that no special skills, requiring continued practice, were necessary.

The procedure described below has been tested by senior undergraduate students with consistently satisfactory results. A manometer and flask may be calibrated with mercury in triplicate by an average student in 60-90 min. The essential feature of the procedure is the construction of a frame (shown in the figure) to hold the manometer.

The Manometer

The manometer is marked (with a glass knife) at the point corresponding to zero on the manometer scale (shown as X on the two diagrams) and at a second point the position of which is not very critical but most conveniently made about 1 cm. above the manometer-flask joint (shown as Y on the diagrams).

The manometer is mounted on the calibration frame using terry clips (C & D). The rubber tubing from the mercury reservoir is fixed to the manometer gas inlet tube (E) with the taps in the positions shown and with

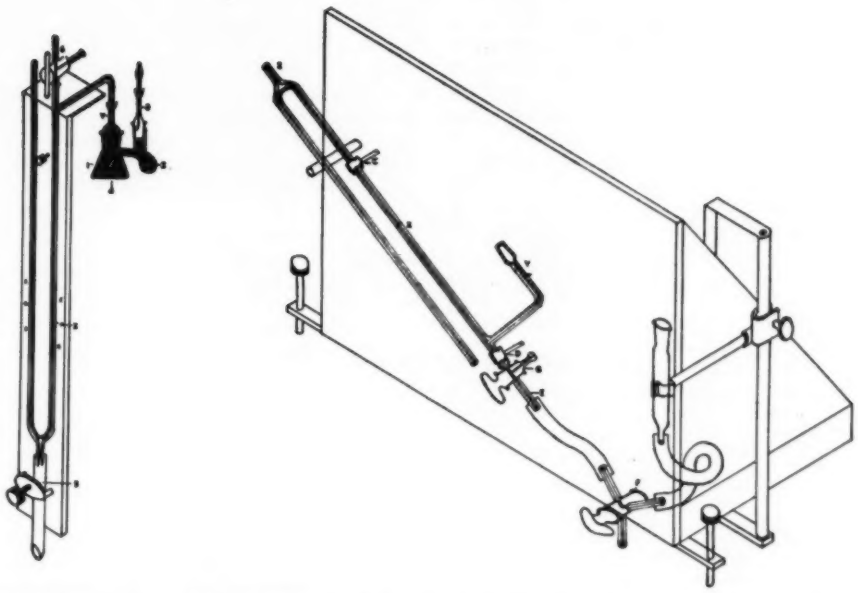


Fig. 1. Warburg manometer and calibration frame. X=zero mark on manometer. Y=calibration mark near the flask joint. Z=outlet on manometer. 1=manometer flask. 2=side-bulb. 3=flask stopper. 4=centre-well. 5=screw for adjusting the level of the manometer fluid. 6=manometer tap. C and D=terry clips for holding the manometer. E=manometer gas-inlet tube. F=control tap to the mercury reservoir.

the reservoir racked down as low as possible using the friction drive fine adjustment knob. The reservoir is raised and the mercury runs into the manometer until it approximately extends from X to Y. By using the adjusting screws on the frame base and the height of the reservoir, the mercury levels in the manometer are exactly adjusted to the two reference marks X and Y. Tap F and secondly tap G are closed and the reservoir is racked down as far as possible. Tap F is then turned to connect the reservoir to the rubber tubing and the manometer disconnected from the tubing at the gas-inlet (E). After carefully removing the manometer from the frame, the mercury is poured from the manometer into a tared weighing bottle through the outlet Z. Some mercury tends to remain in the upper part of the manometer (between the side-arm and the tap); this may be released by slightly easing tap G from its socket. The temperature of the mercury in the weighing bottle is recorded and the bottle weighed.

The calibration of the manometer should be repeated twice, or until three readings are obtained which agree to within 40 mg. *Example:* 3 weighings of mercury each at 24·5°C.: 7·344 g.; 7·336 g.; 7·342 g.

After the calibrations of a manometer, the procedure is more readily repeated if the small amount of mercury trapped in the bore of tap G is removed before re-mounting the manometer on the frame.

The Flask

The stopper (not greased) is inserted into the stopper joint with the gassing pathway open. The flask is filled with mercury and the air bubbles removed by tilting the flask and using a wire probe. The manometer is now fitted firmly into the flask joint and mercury is added or subtracted from the hollow stopper (with a hypodermic syringe) until the mercury level approximates to the reference mark Y on the manometer. The manometer plus flask are now tilted until the mercury level coincides exactly with the mark Y. The stopper is turned to seal off the mercury in the flask. Most of the excess mercury is removed from inside the stopper with the syringe, and the manometer is now disconnected from the flask. The mercury in the cup is poured into a tared weighing bottle, the temperature of the mercury recorded and the bottle plus mercury weighed.

The procedure is carried out twice more or until three readings are in agreement (to within 200 mg.).

Examples: 3 weighings: 323·235, 323·29, 323·20 g. Temperature of each mercury sample: 24·5°C.

Calculation of results: (1) The weighing figures are divided by the density of mercury for the temperature of the mercury weighed (13·5352 g./ml. at 24·5°C.).

The manometer volumes (i.e. volume between marks X and Y) in the example taken averaged to a value of 0·5424 ml.

The flask volume (to the mark Y) averaged to a value of 23·882 ml.

Therefore the mean total volume of flask *plus* manometer to the zero mark = 24·42 ml.

This volume was calculated from weighings which

were in agreement to within 0·02 per cent (i.e. for a flask *plus* manometer, the total weight of mercury = 330·5 and the weighings were accurate to within 250 mg.).

The effect on the cup constant of a much wider range in weighings is as shown below:

If the weight of mercury, for the flask *plus* manometer already considered, was increased to 332 g., i.e. an increase of 1·5 g., the change in the volume of the flask *plus* manometer would be 0·1 ml., *i.e.* total volume increased from 24·42 to 24·52 ml. and this change in the volume of the flask would lead to a change in the $K^{O_2}_{3\cdot2}$ at 30°C. for the flask from 1·94 to 1·95.

The accuracy of the calibration procedure described is well within the experimental limits required for manometric experiments.

Details for calculating cup constants from flask volumes for different gases, temperatures and incubation system volumes are given in Umbreit *et al.* (loc. cit).

REFERENCE

Umbreit, W. W., Burris, R. H., and Stauffer, J. F. (1949). 'Manometric Techniques and Tissue Metabolism', 2nd edn. Burgess Publishing Co., Minneapolis, Minn.

Summer School in Analytical Chemistry

The Royal Institute of Chemistry with the participation of the Society for Analytical Chemistry is to hold a Summer School in Analytical Chemistry at the School of Pharmacy Building, Brunswick Square, London, W.C.1 from August 30 to September 5, 1959.

Three courses, beginning at 9.30 a.m. daily, will run concurrently.

Each full course will be open only to Fellows, Associates and Graduate Members of the Royal Institute of Chemistry and to Members of the Society for Analytical Chemistry. Non-members may attend the lectures only, if there are vacancies.

One introductory lecture on 'Gas Chromatography' and the two final lectures on 'Instrumentation in Analysis' will be delivered to all three courses.

Course I. Instrumental Organic Analysis.—The lecture course will cover recent developments in instrumental analysis as applied to organic compounds. Topics will include nuclear and electron magnetic resonance, infra-red spectroscopy, coulometric titrimetry, polarographic analysis, the use of radioisotopes in analysis, gas chromatography, and electrochromatography.

Laboratory work has been designed at two levels: (1) an elementary course covering some applications to organic analysis of general electro-chemical methods, e.g. polarography, absorptiometry and spectrophotometry. This course is intended for those who have had no previous experience of the relevant techniques. (2) A more advanced course is offered dealing with infra-red and ultra-violet spectroscopy, spectrofluorimetry, derivative and cathode ray polarography, coulometric and amperometric titrations, radiochemical analysis, and an introduction to vapour-phase chromatography. A certain familiarity with instrumental techniques is assumed in this course.

Course Organizer: Dr. D. W. Mathieson.

Lecturers: Mr. E. Bishop, Dr. V. S. Griffiths, Dr. D. J. E. Ingram, Mr. D. A. Lambie, Dr. A. J. P. Martin, Prof. N. H. Martin, Mr. G. F. Reynolds, Dr. R. E. Richards, Mr. S. W. J. Wallis, Dr. H. A. Willis.

Course II. Modern Inorganic Analysis.—The course will be concerned with selected aspects of inorganic analysis in which there have been recent developments in either technique or equipment available. The eight lectures which have been arranged will deal with recent developments and contributions in the fields of complexometry, nuclear magnetic resonance spectra, paper and modified cellulose chromatography, X-ray fluorescence spectrometry, radiochemical techniques, solvent extraction, polarography, amperometric and coulometric techniques, and ion exchange, with reference to inorganic analysis.

Some 20 hours in the laboratory will be devoted to practical work in complexometric, chromatographic, radiochemical, solvent extraction, polarographic, amperometric and coulometric, and ion exchange techniques discussed in the lectures.

Course Organizer: Dr. J. E. Salmon.

Lecturers: Mr. P. D. Ainsley, Dr. H. J. Cluley, Dr. D. A. Everest, Dr. V. S. Griffiths, Dr. E. Kemp, Mr. D. A. Lambie, Dr. A. J. P. Martin, Dr. R. E. Richards, Dr. J. E. Salmon, and Mr. S. W. J. Wallis.

Course III. Gas Chromatography.—This course will comprise eight lectures covering all aspects of the technique including the general theory, presentation of data and the design and construction of apparatus. The latter will include lectures on vapour detectors, high efficiency columns and the role of the stationary phase. In addition, application of the technique in the biochemical field, in the production of fine chemicals, and in the petroleum industry will be described.

Practical sessions will take place each afternoon following the lectures. Experimental work will be directed to provide a broad experience of the setting up and operation of a variety of apparatus, and will include the determination and correlation of retention volume data and quantitative analysis. It is hoped that specimens of many commercial instruments will be available for exhibition.

Course Organizer: Mr. D. H. Desty.

Lecturers: Dr. D. Ambrose, Mr. D. H. Desty, Dr. V. S. Griffiths, Dr. A. T. James, Dr. A. I. M. Keulemans, Dr. J. E. Lovelock, Dr. A. J. P. Martin, Mr. R. P. W. Scott, Dr. G. A. P. Tuey, Mr. S. W. J. Wallis.

The Summer School will open with an address by Prof. W. H. Linnell, D.Sc., F.R.I.C., Dean of the School of Pharmacy.

There will be a discussion on Tuesday, September 1, opened by Mr. R. C. Chirnside. Before the discussion there will be an informal supper to which all attending the Summer School are invited.

It is proposed to hold an informal dinner in the evening of Friday, September 4, 1959.

Fees

1. For attendance at the School:
   (*a*) for any one course (1, 2 or 3) with appropriate practical work (including the cost of morning coffee, lunch, afternoon tea, and the informal supper before the evening meeting) .. .. 23 guineas
   (*b*) for lectures only of any one course (including cost of morning coffee)—members 5 guineas
   —non-members .. .. 7 guineas
2. Informal dinner .. .. 1 guinea
3. Residential accommodation .. .. .. 6 guineas

Places will be allocated in the order in which applications for registration are received. Those wishing to take part are therefore requested to complete the form and return it, together with a Registration Fee of 5 guineas, without delay to: The Education Officer, The Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

BOOK REVIEWS

Steric Effects in Conjugated Systems. Proceedings of a Symposium held at the University, Hull, July 15 to 17, 1958, by The Chemical Society. Edited by G. W. Gray, B.Sc., PH.D. 1958. London: Butterworths Scientific Publications. U.S.A.: Academic Press Inc. 30s. pp. 181 + viii.

This is a series of specialist monographs by well-known international authorities on the subject of the title. The Symposium was introduced briefly by Prof. E. E. Turner with a historical summary of the diphenyl problem, to which he has made several contributions; Prof. Coulson deals with the relation of deformation in aromatic hydrocarbons and electronic energy levels, largely in relation to condensed aromatic hydrocarbons and aromatic hydrocarbon assemblies. Dr. G. H. Beaven discussed the investigation of steric problems in substituted diphenyls by U.V. absorption spectroscopy and Dr. C. C. Barker deals with similar applications in the basic di- and tri- phenylmethane dyes.

In all cases the discussion which took place is fully recorded and proves a useful addendum to the paper itself. The colour of cyanine dyes, as influenced by non-coplanarity of the molecule, is discussed by Prof. M. J. S. Dewar and the U.V. absorption theme is continued by Dr. W. F. Forbes and by Dr. E. S. Waight and Mr. R. L. Erskine. Dr. E. M. Wepster from Delft correlated structure and properties of a group of simple aromatic compounds with their electronic spectra. This paper provoked a lengthy and profitable discussion as also did the subsequent paper by Prof. H. C. Brown of Purdue University, on the solvolysis of substituted phenyldimethylcarbinylchlorides.

Prof. N. B. Chapman spoke on the steric effects in nucleophilic aromatic substitution and Mr. Farthing and Mr. Nam correlated the effects of *ortho*-substituents on aromatic side-chain reactivity by the successful application of a Hammett-type equation. Dr. J. W. Smith evaluated the effect of dipole moment on steric effects in aromatic molecules. Dr. Dallinga and two colleagues deal with similar problems in the interaction of protons and aromatic hydrocarbons and Dr. G. W. Gray indicated the results of his experiments on dibenzylideneaminodiphenyls. The volume concludes with a study by Dr. E. A. Johnson of the use of vapour-phase chromatography in the stereochemical examination of alkyldiphenyls.

This well-produced volume is a credit to the Society, the publishers and, of course, the contributors and will for some time at least, be a useful handbook for current views on this field of stereochemistry.—G. M. DYSON.

Analytical Chemistry—Some New Techniques, by A. G. Jones, B.Sc., F.R.I.C. London: Butterworths Scientific Publications. 1959. 40s. pp. 268 + vi.

A publisher's note on the fly leaf of the dust cover states that 'this book is aimed at supplying non-specialist senior analysts with an introduction to a number of the techniques of analytical chemistry which have been developed during the last few years'. Dr. Jones has succeeded admirably in his task and one can have nothing but admiration for this little volume. Perhaps the author assumes that those senior chemists for whom he is writing were at college a little later and, therefore, perhaps a little more in touch with actual laboratory techniques than the reviewer, but just as an author is entitled to assume that his reader can understand the basic language in which a book is written, so Dr. Jones is entitled to assume that his readers have endeavoured to keep abreast of current analytical chemistry. Working on this assumption the author has prepared eight monographs on the techniques of flame photometry, differential spectrophotometry, gas chromatography, the use of ion exchangers in analytical chemistry, acid-base titrations in non-aqueous media, coulometric titrations, differential refractometry, and the determination of oxygen and hydrogen in metals. The style is simple and straightforward; each monograph opens with a short historical note, if one may write of the history of a subject some 10 to 20 years old, and is followed by describing the basic principles and the various types of apparatus and process available at the time of publication. The text is fully annotated with reference numbers to the bibliography at the end of each monograph, which give some 30 to 65 references to text-books and original papers on the subject of the mongraph, an arrangement which gives the busy reader an adequate selection on any point he wishes to study further. Useful hints, which are of the greatest importance to the non-specialist senior handling an enthusiastic junior, are given on practical points, such as the information that a trace of water does not generally upset a titration in a non-aqueous medium, but that atmospheric carbon dioxide may do so.

One can do nothing but praise this little volume. It is one that can be recommended to every chemist, whether specialist or not, because few can be specialist in all the eight techniques described. Printers' errors are remarkably few though there is an interesting one on p. 160, where the division of a word at the end of a line introduces us to 'acrylon-itrile'.—THOMAS MCLACHLAN.

Recent British Standards

A new publication Methods of Testing Vulcanized Rubber (B.S. 903) Part B19:1958—'Preparation and examination of water extract (price 3s.) is part of the revision and publication in separate parts of B.S. 903 (Methods of testing vulcanized rubber). It deals with the preparation and examination of water extract and replaces Part 12 of the 'one-volume' edition published in 1950.

As well as specifying the method of preparing the water extract, the eight-page publication provides detailed methods for determining total water soluble materials, electrical resistivity, free acid or free alkali, pH value, chloride, sulphate, and ammonium salts.

Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

AUTOMATIC READER FOR HIGH-PRECISION BALANCES

THE National Bureau of Standards has developed a photoelectric device that automatically and continuously indicates the position of the swinging beam of a high precision balance[1]. At the same time it provides a greatly increased reading sensitivity, the minimum readable displacement on the scale being 0·0001 in. as compared with 0·004 in. for the conventional visual method.

Design and construction of the apparatus are due primarily to L. B. Macurdy and H. A. Bowman. Consultation was provided by M. L. Greenough and T. R. Young, also of the Bureau staff; and the instrument was made largely in the Bureau's instrument shop.

Primarily a Research Tool

The device was developed primarily as a research tool for obtaining a better understanding of balance errors; data from such studies are now being accumulated and will be used in working out improved balance designs. The photoelectric reader can provide data on the motion of the balance beam (i.e. of the horizontal arm from which the balance pans are suspended) in two forms: (1) as a voltage whose magnitude represents the instantaneous position of the beam; or (2) as numerical data that represent turning points (extremes of the swing), from which masses may be calculated. A plot of the output voltage on a recorder forms a graph that can be used in evaluating the dynamic characteristics of the oscillating structure. The turning points are read from a dial that ordinarily indicates the instantaneous position of the beam but which remains stationary for a brief interval after each turning point is reached.

1. Further technical details are given in the paper 'The observation and control of errors due to changing ambient conditions during high-precision weighing experiments', by L. B. Macurdy, H. A. Bowman, and H. E. Almer, delivered December 30, 1958, at the Washington meeting of the AAAS, session on 'Precision Measurements' conducted by the ISA.

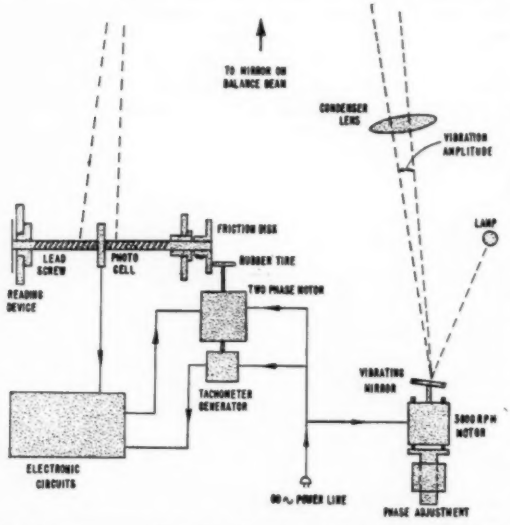


Fig. 1. Interconnection of main components of the automatic reader for high-precision balances.

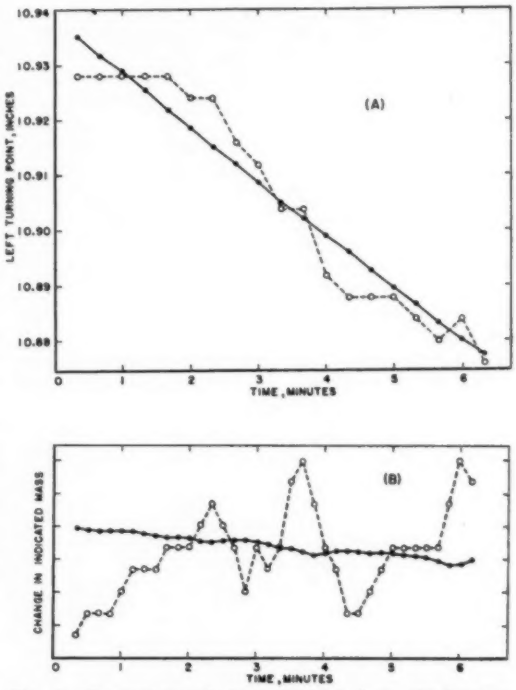


Fig. 2. Comparison of data obtained from simultaneous observations of a high-precision balance by conventional visual method (open circles) and by use of photoelectric reader (black circles). (A), observed left turning points. (B), the corresponding computed values (using both left and right turning points) of the indicated mass.

Though primarily a research tool, the photoelectric device also contributes in a more direct way to reduce the errors in precision mass measurements. Major errors in such measurements are due to small changes in temperature and humidity that occur during the course of the experiment. Since the automatic reader makes it possible to increase the speed of balance operations by from five to ten times, it shortens the interval during which these changes in ambient conditions can act. Faster operation also increases the 'on scale' range of the balance; and this permits the use of larger—and hence more accurate—sensitivity weights. The disadvantage of high-speed operation is that it ordinarily results in losses of readability and deflection sensitivity. However, the high reading sensitivity of the present instrument more than compensates for these losses.

Basic Design of Reader

The basic design of the reader is fairly straightforward (Fig. 1). A narrow beam of light is sent towards the balance and is reflected by a mirror on the balance beam back to the slit at the front of a photocell. Besides swinging with the motion of the balance, the light beam has a small 60-c/s vibration of its own (amplitude about 1 minute of arc). This facilitates the design of a servo loop to maintain the photocell

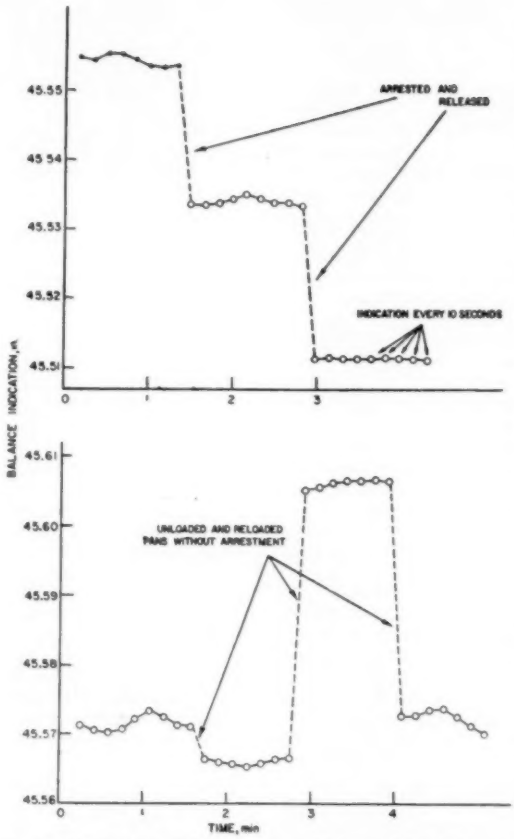


Fig. 3. Mechanical difficulties in a high precision balance indicated by use of automatic reader. Above, effects of a loose screw in the arrestment mechanism. Below, errors caused by misalignment of the load transfer mechanism.

slit centred on the light beam. When light beam and slit are not in line, an 'error signal' is generated, and this controls a two-phase motor that turns the lead screw on which the photocell is mounted. By suitable design and adjustment of the components, the photocell is made to follow the swinging light beam to within about 0·0002 in., corresponding to 4×10^{-5} degree in the angular position of the balance arm.

The position of the balance beam is thus represented by the angle turned through by the lead screw. The latter drives a dial which has a single turn of free play so that when the direction of the lead screw reverses (i.e. at a turning point) the dial remains motionless for one revolution of the screw. To obtain a voltage proportional to the position of the balance beam, the lead screw is mechanically coupled to the pickoff arm of a precision potentiometer.

Operation of Reader

A fixed, single-filament lamp is the source of light. The light is first reflected from a rotating mirror whose plane is tilted slightly from the plane normal to the axis of rotation. A simple arrangement allows the angle of tilt to be set at any value up to 1 minute of arc. Since the mirror is rotated by a 3,600 rpm motor, the reflected light beam vibrates at 60 c/s with a peak-to-peak amplitude adjustable from 0 to 2 minutes of arc. The phase of the 60-c/s vibration can also be adjusted with respect to the 60-c/s power supply by rotating the entire motor in its mount.

After reflection from the rotating mirror the light beam passes through a condensing lens and proceeds (by way of a mirror mounted on the balance frame) to the mirror on the moving arm of the balance. Returning towards the photocell, the light beam produces an image of the lamp filament on the plane of the photocell slit; the slit and filament image are both about 3/64 in. wide.

Because of its 60-c/s vibration, the filament image vibrates back and forth through a distance of about 3/16 in. When the slit is located in the centre of this vibration it is illuminated 120 times a second. However, if it is displaced from the centre of the vibration, the electrical output of the photocell will contain a 60-c/s component whose phase and magnitude depend, respectively, on the direction and amount of the off-centre displacement.

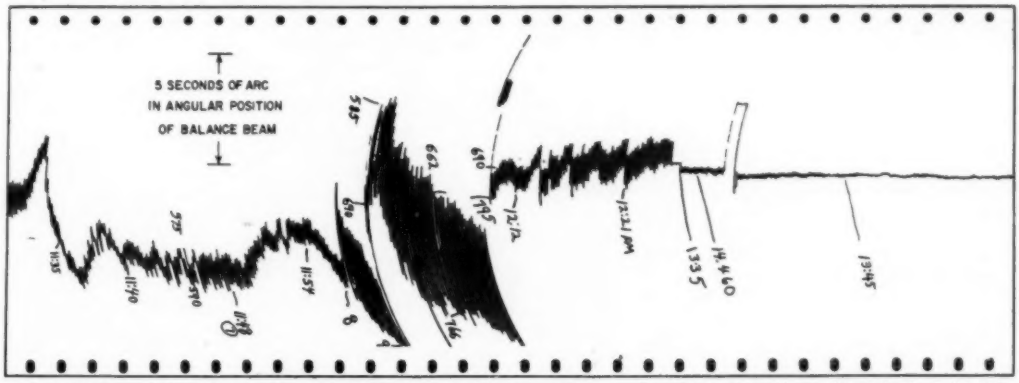


Fig. 4. Photograph showing continuous record of balance-beam motion, made with automatic reading device. At left, balance was under the influence of unstable air masses caused by small thermal disturbances inside the balance case. At right, after the air had become quiescent, only very low-level background 'noise' is detected. Note that operation of the reader was suspended for about 70 minutes starting at approximately 12.24 p.m; also, that the recorder pen was recentred twice when the indication went off the paper during the disturbed period.

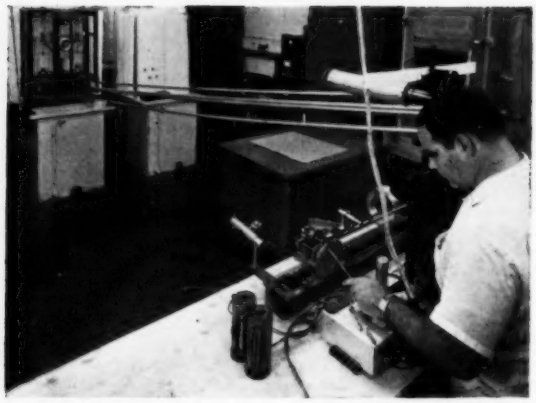


Fig 5. The photoelectric reader for high-precision balances on table in foreground; balance (upper left) is manipulated by the long rods. The operator is noting the turning-point position of the balance beam as indicated on reader dial; the dial remains stationary for a short interval after each turning point. The device can also provide a continuous record of the motion of the balance beam.

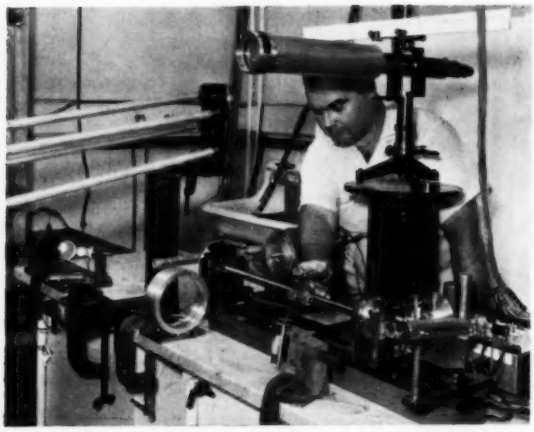


Fig. 6. Automatic reader for high-precision balances is put into operation. Photocell, which is driven by a servo loop to follow a light beam from the balance (not shown), is here brought into initial alignment with the light beam. Telescope (above) is used for conventional visual observations of the balance beam.

The 60-c/s component is filtered, amplified, and applied to the control winding of the two-phase motor. This motor then drives the lead screw in the proper direction to recentre the slit, provided that the supply voltage used to excite its reference winding is in appropriate phase with the 60-c/s vibrations of the light beam. The same supply voltage is applied to both motors: and, as indicated above, the relative phase of the 60-c/s vibration of the light beam is adjusted by rotating the 3,600-rpm motor about the axis of its shaft (Fig. 1). A tachometer generator provides a velocity-damping signal to prevent oscillations around the servo loop.

The position of the balance arm at any instant can then be accurately determined from the angular position of the lead screw. The lead screw is 20 in. long with a two-start thread, 10 pitch, ground from SAE 6150 steel hardened to Rockwell C 55. The lead screw has a 0·0004 in. lead eror fairly well distributed along its length and is driven by a rubber tyre and friction disc. The plane of the thrust bearing supporting the disc provides a reference from which displacement measurements of the photocell are made.

At the opposite end of the lead screw is the reading dial with 100 graduations spaced about 1/8 in. apart, each representing 0·001 in. of photocell displacement. This dial has one turn of free play so that it remains motionless for one revolution of the lead screw when the latter reverses direction. During this interval the turning-point reading remains unchanged, permitting the operator to make an accurate estimate of the extreme position of the photocell to 1/10 of a division or 0·0001 in.

Background Noise

Zero stability of the apparatus, determined from observations on a light beam reflected from an arrested (and therefore presumably motionless) balance, is about 2 micro inches per minute. This drift changes direction roughly twice daily, and may therefore, be associated with some diurnal motion of the building or piers. There are occasional bursts of 'noise' of about $+0{\cdot}0003$ in., some of which have been correlated with starting and stopping of building elevators. However, the total effect of all noise is not considered serious enough to warrant additional noise studies at this time.

Comparison with Conventional Method

The effectiveness of the automatic reader a as tool for investigating the errors of precison balances rests on the considerable improvement in reading accuracy that it provides. This improvement appears very clearly from the results of a test in which readings were taken simultaneously by the old and new methods. An experienced telescopic observer made readings—'on the fly'—of the turning points in the moving image of a millimeter scale, reading directly to millimeters and estimating tenths of millimeters. Another observer read off the turning points from the motionless dial of the photoelectric device, reading directly to thousandths of an inch and estimating tenths of thousandths of an inch.

When plotted on a graph (Fig. 2A) the readings from the stationary dial lie on a relatively smoother curve, less disturbed by random fluctuations. The same result appears from a graph of the calculated balance indications based on the two sets of readings respectively (Fig. 2B).

The reader is currently being used to evaluate mechanical features that are under consideration for inclusion in a short-period high-precision automatic weighing system for which preliminary studies are under way. Already a number of useful results have been obtained. In one study, for example, the device has been used to show the effects of errors associated with a certain type of arrestment mechanism, while, another has shown the reloading error in a balance of one design when operated without arrestment (Fig. 3).

School Science Laboratories

According to the chief press officer of the Ministry of Education, £2 million is now being spent each year on laboratory buildings at maintained secondary schools, and it does not include the cost of ancillary accommodation, apparatus or loose equipment. He estimates that since the war about £17 million has been spent on providing some 4,000 laboratories and about £5 million more on equipping them.

INTERNATIONAL SYMPOSIUM ON MICROCHEMISTRY

PART I

Organized by the Midlands Section and the Microchemistry Group on behalf of the Society for Analytical Chemistry, and held under the patronage of the International Union of Pure and Applied Chemistry, the International Symposium on Microchemistry took place at Birmingham University from August 20 to 27, 1958. Summaries of many of the lectures are given and those requiring the whole of the papers will be interested to know that the lectures and discussions are to be published in full by Pergamon Press Ltd. as the Proceedings of the Symposium.

No. 1. Opening of Proceedings by the Symposium President, Prof. M. Stacey, F.R.S. and Presentation of Addresses.

No. 2. The Use of Pyrolytic and Pyrohydrolytic Cleavages in Spot Test Analysis, by F. Feigl.—When pyrolyzed alone or with certain inorganic partners many organic compounds yield volatile cleavage products which can be identified in the gas phase with appropriate reagents. Hydrolysis can play an important part in these reactions, the water coming from the decomposition of the organic compound or from the inorganic additive. Under such conditions, hydrolyses take place which are not normally found. Many of these pyrolytic and pyrohydrolytical cleavages of analytical interest are described, and the importance of future development discussed.

No. 3. Analytical Problems in the Electrical Industry: the Application of Micro-Techniques, by R. C. Chirnside.—Selected examples of the analysis of small quantities in the electrical industry are given. These include the study of the reaction of magnesium and beryllium with carbon dioxide, the depth of penetration of carbon into zirconium, the effect of carbon monoxide and dioxide mixtures on iron, the determination of very small quantities of cobalt in steel, boron in carbon and impurities in carbon dioxide. These illustrate the wide range of techniques used, including not only chemical methods but also spectrographic, mass spectrographic, polarographic, absorptiometric and conductimetric methods, and X-ray diffraction. These are regarded as micro-analysis, and are representative of developments over a much broader front than was formerly included in the term.

No. 4. Rapid Methods of Micro-determination of Fluorine, Chlorine and Sulphur in Organic Compounds. Applications of Combustion with a Micro Oxyhydrogen Blast Burner, by R. Levy.—The oxy-hydrogen combustion provides aqueous solutions of fluoride, chloride and sulphate ions respectively. The fluoride ions are titrated indirectly through the reaction of hydrofluoric acid with silica in an alcoholic medium in the presence of potassium chloride. Chloride ions are titrated by argentometric potentiometry, and sulphate ions are titrated with barium chloride with sodium alizarin sulphonate as an adsorption indicator in the presence of a suspension of barium sulphate. Results are satisfactory and the investigations are to be extended.

No. 5. Some Experiences in the Determination of Sulphur and Halogens, by W. J. Kirsten.—The determination of sulphur by combustion and subsequent hydrogenation has been improved. Alkaline potassium iodate is used for the absorption and oxidation of the hydrogen sulphides formed, and the excess of iodate is back-titrated with this sulphate after acidification. Nitrogen and halogens do not interfere, and the interference from phosphorus is negligible in micro-analysis. A procedure for the determination of chlorine in volatile liquids according to the Mikl and Pech—Schöniger method is described.

No. 6. The Microdetermination of Nitrogen by a simple Modification of the Pregl-Dumas method, and some observations on Methane as a source of error, by A. F. Colson.—The numerous attempts which have been made to eliminate errors due to retention of nitrogen by carbonaceous sample-residues, or to incomplete oxidation of methane, in the normal Pregl-Dumas method, are summarized, and a new modified procedure is described. Experimental evidence is given to support the view that the incomplete oxidation of methane is more pronounced in the macro-Dumas method than in the normal Pregl-Dumas procedure, and that the latter is less subject to error from this source than is generally supposed.

No. 7. Radioisotopes in Microbiochemical Research, by F. P. W. Winteringham.—The combined application of radioactive tracer and micro-fractionation techniques such as chromatography has brought new and extensive fields of biochemical research within the range of quantitative analysis. Their successful application involves first the introduction of suitable radioisotopes into the system to be studied followed by adequate techniques of fractionation and identification. The methods of using labelled reagents, radioactivation, and the labelled pool technique for fulfilling the first condition are described. Methods for characterizing and identifying labelled compounds separated on paper chromatograms in amounts below the limits of chemical detection are also discussed.

No. 8. Determination of Trace Elements in Semi-conducting Materials, by J. A. James.—The effect of impurities in semi-conductors, and the extent to which the analytical requirements are met by radioactivation and mass spectrometry are briefly reviewed. The problems of unambiguous identification of impurities by radioactivation are discussed in terms of the activation process, chemical separation and radiochemical purity, with particular reference to the analysis of silicon. The field of use of the solid source mass spectrometer is discussed in relation to the preparation and purification of intermetallic compounds. In the case of silicon its limitations are compared and contrasted with the isotope dilution technique.

No. 9. The Determination of Minute Amounts of Fission Product Activity in Waters and Biological Materials, by F. J. Bryant, R. G. Osmond and G. S. Spicer.—Radiochemical methods are described for investigating the world-wide distribution of fission products from nuclear explosions and for measuring the movement of radioactive strontium through the food chain to the human body. Details are given of the techniques employed for the determination of ^{90}Sr and ^{89}Sr in rainwater, tapwater, soil, vegetations, cereals, milk and bone, and of ^{141}Ce, ^{144}Ce, ^{140}Ba and ^{137}Cs in waters. Special precautions and low background counting equipment

are necessary because of the small amounts of activity involved (in some cases as little as a few micromicrocuries) and these are briefly mentioned. Typical results are quoted and discussed in comparison with those obtained by other workers.

No. 10. The Determination of Sub-microgram Amounts of Cadmium in Super-pure Zinc by Neutron Activation Analysis, by D. Gibbons.—A method has been developed for the radiochemical purification of cadmium in irradiated zinc, and this has been applied to the determination of cadmium in high purity zone-refined zinc by activation analysis. The ultimate sensitivity with irradiation in the Harwell pile (BEPO) is 10^{-9} g. of cadmium, and the purification procedure described will give, at this level, a product which contains less than 1 per cent of detectable impurity.

No. 11. Solid-electrode Voltammetry and Amperometric Microtitration, by John T. Stock.—Solid voltammetric electrodes have proved their value in the microanalytical field and their use appears to be extending. Recent investigations concerning the fundamental properties of such electrodes and the causes and elimination of anomalous effects will doubtless favour this trend. Although vibrating or rotating electrodes are commonly employed, the extremely simple stationary form is of considerable value under appropriate conditions. The wide range of working potentials in solvents other than water and the lack of volatility possessed by noble-metal solid electrodes should further such techniques as nonaqueous titrimetry and investigations in fused-salt media.

No. 12. Recent Developments in the use of the Ring Oven, by H. Weisz.—Since the ring oven was first described in 1954, its use has been extended to include the separation and detection of further elements. Work is in progress on a scheme for the detection of several anions. Combined with electrography, the technique has been used in the identification of alloys. Semi-quantitative use of the oven can achieve ± 5 per cent on samples of 1-2 μg. and has been applied to copper, to impurities in filter paper, and to alloys. Radioactive materials can be separated in very small quantities and detected using photographic film. Applications to various fields of analysis are outlined.

No. 13. Practical Applications of Chemical Microscopy, by Phillip W. West.—Some applications and techniques of current interest in chemical microscopy are reviewed with a view to stressing the valuable information which may be obtained with relatively little specialized training and moderately priced equipment. These include simple morphological studies under ordinary light, the methods of extending information by the use of polarized light, the use of fusion methods for organic compounds in both analysis and research, and the applications to the identification of fibres and atmospheric dusts.

No. 14. Second Plenary Lecture: Forty Years of Quantitative Organic Microanalysis, by Hans Lieb.—Classical methods of microanalysis were established by Pregl some 40 years ago. The progress of this special branch of analysis up to the present day is surveyed. Developments in balance design and in the determination of the conventional elements, metals, functional groups and molecular weight are considered, and reference is made to the work of committees charged with the task of recommending standard apparatus and test substances.

No. 15. Biochemical Applications of Absorption Spectra in the Visible and Ultraviolet Regions, by R. A. Morton.—The application of older spectroscopic techniques to modern biochemical problems such as the study of co-enzyme A, and the value of newer spectrophotometric techniques for identifying substances, such as indole-3-acetic acid and related compounds, present in minute amounts in biological material, and also for clarifying complicated enzymatic and photochemical processes, are described. Reference is made to difference spectroscopy, the determination of di-, tri- and poly-ene acids and the effect of irrelevant absorption caused by impurities on the quantitative determination of absorbing substances.

No. 16. Current Trends in Infrared Structural Diagnosis, by L. J. Bellamy and R. L. Williams.—There is a trend towards specialized correlations in particular classes of compound which can give detailed information about structure. Vibrations which depend on the same force constant, such as the asymmetrical and symmetrical NH_2 stretching modes, follow a linear relationship and can provide a useful check on identification. Absolute intensity measurements give additional structural information: thus the carbonyl frequency of 1720 cm^{-1} is found for several types of compound, but these can often be distinguished by their characteristic intensities. Frequency changes with the solvent often follow a common pattern, and this can sometimes assist in identification of a particular vibration. Preliminary separation by gas chromatography prior to infrared analysis has proved useful.

No. 17. The Spectrochemical Analysis of Solutions, by Mr. F. W. J. Garton.

No. 18. Flame Photometry using Microsamples and Microconcentrations, by F. Burriel-Marti.—Flame photometry has certain inherent limitations and it is necessary to take special precautions to standardize conditions. To ensure the maximum sensitivity a hot flame using an oxy-hydrogen burner is recommended. Narrow band filters or a monochromator are necessary but each problem may require individual consideration to obtain greatest light intensity while minimizing interference from adjacent lines. Where traces are being determined in the presence of microconcentration of the elements, it is possible to secure better sensitivity by removing these elements while concentrating the traces. Typical applications are discussed with special reference to the interferences experienced within the flame and methods of reducing these.

No. 19. The Separation of Fission Products on Ion-exchange Micro-columns, by E. A. C. Crouch and I. G. Swainbank.—Ion-exchange techniques have been applied to the separation of microgram quantities of fission products on very small columns. The complete separation of all the rare earth elements has been achieved on a cation-exchange microcolumn, the separation being controlled by using induced radioactivity, and also by detecting visually the separated elements as oxalate precipitates. Volumes of solution have been sufficiently small to enable their direct application to the ion-source of a mass-spectrometer. Other examples of separations are given. An electronic apparatus is described for the control of the column separation of radioactive mixtures, as well as a device for giving continuous automatic pH change in the eluent used on cation-exchange microcolumns.

No. 20. Standardization of Microchemical Apparatus and Methods in the United States of America, by Al Steyermark.—Three separate organizations are sponsoring standardization activities with regard to microchemical apparatus and methods in the United States of America. They are the Division of Analytical Chemistry of the American Chemical Society, the American Society for Testing Materials, and the Association of Official Agricultural Chemists. The first two organizations sponsor the work on apparatus while the third

is interested in methods, but all their programmes are closely related. The American Chemical Society group recommends specifications for apparatus, after which the American Society for Testing Materials makes them standards. As well as certain pieces of volumetric glassware, the apparatus studied so far includes that for the determinations of carbon-hydrogen, nitrogen (Dumas and Kjeldahl), halogens, sulphur and alkoxyl. Methods include these, and in addition oxygen, phosphorus and molecular weight.

No. 21. The Role of Perchloric Acid in Macro-Wet Oxidation of Organic Matter in the Preparation for Micro-Determination of Trace Elements, by Harvey C. Diehl and G. Frederick Smith.—Wet oxidation methods are of major importance in analytical control. Perchloric acid, alone or mixed with sulphuric or nitric acids, can give outstanding results, hazards arising only through unwise or careless use. A wide and controllable range of oxidation potential can be achieved, and analytically important metals and non-metals are retained in a form which facilitates their determination, without deposition of charred carbon. The oxidation mixture can readily be purified from trace elements. Reaction rates may be materially increased and completeness of reaction ndicated by using vanadium or chromium as catalyst. The course of typical wet oxidation reactions for differing types of material is described.

No. 22. Polarography in Microchemistry, by G. Semerano.—By means of instrumental devices and modifications of operating procedure some authors have been able to eliminate the difficulties arising in polarographic microdeterminations. Some of these methods are briefly discussed and attention is drawn to the most recent, e.g. oscillographic polarography alternating current polarography and square wave polarography from the standpoint of microanalysis.

Some applications in the field of metallurgy, mineralogy medicine, toxicology and industrial hygiene are illustrated. Particular attention is given to the applications to radiochemistry since polarography allows remote analytical control and thus reduces the hazards undergone by personnel engaged in this kind of research.

No. 23. Applications of the Overtone Region in Infra-red Analysis, by R. G. Miller and H. A. Willis.—The near infra-red region (1-2·5 μ) has a number of practical advantages and, whenever possible, should be used rather than the 2·5-15 μ region for quantitative work. When the system to be examined permits measurements in the near infra-red region, reliable, convenient and speedy methods that are well-suited for routine analysis are readily devised. Several analyses in the plastics field are described.

No. 24. Quantitative Analysis in the Infra-red, by A. R. Philpotts and W. F. Maddams.—Recent developments in the application of infra-red spectroscopy to quantitative analysis are critically reviewed. Various sources of error, such as those dependent on the physics of measurement, the chemical nature of the sample and overlapping absorption bands, are discussed, and methods for overcoming these sources of error suggested. Procedures for accurate optical density and absorption band area measurements are given and difference and derivative spectra described. Recent advances in infra-red instrumentation and sample preparation techniques are mentioned and their significance for microchemistry discussed.

No. 25. Paper Chromatography of Inorganic Ions, Part XVIII. Separations with some Solvents containing HF, by A. Grand-Clement, Z. Jakovac, M. Lederer and E. Pluchet.—A two-dimensional separation, first methanol-ethanol-HCl, then with butanol-HCl-HF, has been successful with artificial mixtures resembling fission products. The behaviour of inorganic ions in butanol-HCl-HF-water, in butanol-H_2-SO_4-HF-water and in acetone-HCl-HF-water has been studied, and numerous R_F values of cations are given. Acetone-HF-HCl and acetone-HF-water have been used to study the behaviour of protoactinium in mixtures with tantalum, niobium and zirconium.

No. 26. Chromatography of the Larger Molecules, by Tudor S. G. Jones.—Problems peculiar to the chromatography of the larger molecules as distinct from small molecules arise mainly when the scale of separation is such as to provide material for further work. Elution development has been applied to many classes of high molecular weight organic substances. Both paper and column chromatography has been used, with solvents of constant, systematically varied and continuously varied composition, and employing both predominantly adsorptive and predominantly partition stationary phases. Ion exchange resins have provided the most versatile of the chromatographic media and, of these, the lighter cross-linked have proved most useful, particularly in displacement development, where the scale may be many times larger than that of elution analysis. Proteins, polypeptides, nucleic acids, synthetic organic compounds and high polymers have all been separated chromatographically by one means or another.

No. 27 a. The Separation and Determination of Traces of Organic Substances by Chromato-polarography, by W. Kemula.—The basic principles of chromato-polarography, which is a combination of chromatographic separation with continuous polarographic detection, are briefly described. For organic applications 'inverse' liquid-liquid chromatography is employed, and the stationary organic phase is held on a solid support such as powdered rubber or a polymer. The simultaneous separation and detection are described of a number of organic mixtures which are normally difficult to analyse. These include the isomers of nitroaniline, chlorodinitrobenzene and dichloronitrobenzene, and the homologues of the lower aliphatic nitro compounds. Certain drawbacks are outlined and a means of overcoming some of them by the use of a differential system is described. It is suggested that the technique is neither chromatography nor polarography, but is a distinct new method.

No. 27 b. The Determination of Minute Amounts of some Inorganic Ions using the 'Hanging' Mercury Drop Electrode, by W. Kemula.—The application of the hanging drop mercury electrode, used with a conventional polarograph, to the analysis of minute concentrations of metallic ions is described. It is shown that concentrations of 10^{-8} moles/l. can be determined with ease, while in the most favourable conditions it appears likely that as little as 10^{-10} moles/l. could be measured. The total volume required for an analysis is only about one ml. Sensitivities attainable with this electrode are of the order of 10^3 to 10^5 times as great as those attained by conventional polarography.

No. 28. Polarographic Microanalysis in Reaction Kinetics, by P. Zuman.—The advantages and limitations of the polarographic method for kinetic studies of homogeneous chemical reactions in solution are discussed. Among the limitations are the necessity for one or more, of the reactants, or products, to undergo reduction or oxidation, at the dropping mercury electrode and for all reactants and products to be soluble in a solvent which is also capable of dissolving a base electrolyte in an ionized form. The advantages are the great velocity of measurement and sensitivity that is attainable, and continuous measurement which may often be made without interfering with the reaction. The

sensitivity permits the use of very low concentrations, with all its attendant advantages. Studies of the reactions of periodate with dihydrobenzoin and with 1, 2-diols are discussed in detail to illustrate these general points.

No. 29. Polarographic Microanalysis by an Oscillographic Method, by R. Kalvoda.—A special microanalytical polarographic method is described, based on the previous accumulation of reducible ion species at a stationary mercury electrode with subsequent analysis of the amalgam formed. It is shown that the method can be used for direct determination and also for separation and determination of interfering species.

The instrument used for this work was the oscillographic polaroscope of Heyrovsky and brief details of the operation and facilities are given.

By various modifications described it is claimed that the elements Cu, Sn, Bi, Cd, In, Pb, Tl, Zn, Ba, Sr, Na and K may be determined in the concentration range 10^{-5} to 10^{-9} Molar.

No. 30. Microdetermination of Functional Groups, by Prof. T. S. Ma.

No. 31. Specific and Selective Organic Reagents, by F. J. Welcher.—The search for new specific and selective analytical reagents is still largely empirical, but recently efforts have been made to establish the principles upon which the synthesis of successful new compounds can be based. The most useful organic reagents are those which form chelate compounds with metal ions. The stability of the chelate, upon which its analytical characteristics depend, is related to the size of the chelate ring, the number of metal chelate rings per ligand, the basicity of the ligand and resonance effects. Substitution may alter the basicity and the resonance, and may cause purely steric changes. Examples of all these effects are given, and an investigation based on them, into the development of a new reagent is described.

No. 32. Trends in Qualitative Analysis, by A. A. Benedetti-Pichler.—The teaching of qualitative analysis through the identification of more or less simple compounds has a close agreement with applied qualitative analysis, and is less tedious than the usual application of separation schemes to artificial mixtures. Organic substances and rare elements should be included, and samples must be small. Observations should be made of appearance under the polarizing microscope, hardness, refractive index, melting point and behaviour on heating in various gases. Solubility, and reactions of drops of solution, supplement the information, and confirmatory tests are done on specks of material. The techniques can be extended to microgram and sub-microgram quantities.

(*To be continued*)

Forthcoming Congresses and Conferences

The Twelfth Laboratory Animals Centre Congress is to be held at the Royal Veterinary College, London, N.W.1, on Tuesday, and Wednesday April 14 and 15, 1959.

The provisional programme is as follows:

Tuesday, April 14:

Morning—Chairman: Dr. Annie M. Brown, Laboratory Animals Centre, Carshalton, Surrey.

9.30 a.m. Opening of Congress by Prof. A. A. Miles, Director, Lister Institute of Preventive Medicine, London.

10 a.m. Frequency at which Blood can be drawn from Farm Animals, by Mr. R. Cook, Ministry of Supply, Allington Farm, Porton Down, Salisbury.

10.40 a.m. Coffee.

11.10 a.m. Observations on a Large Guinea-Pig Unit, by Mr. D. Williamson and Mr. J. Davis, of the Research Institute (Animal Virus Disease), Pirbright.

11.50 a.m. Transport of Live Laboratory Animals, by Mr. Michael P. K. Castle, College of Technology, Department of Pharmacy, Ashley Down, Bristol.

12.30 p.m. Lunch, and Trade Exhibition Open.

Afternoon—Chairman: Mr. H. Ling, Department of Pharmacology, Oxford.

3.30 p.m. Some Aspects of Dog Management, by Mr. H. O. Nevin, Department of Surgery, The Queen's University of Belfast, Institute of Clinical Science, Belfast.

4.10 p.m. Animal Breeding and Genetics, by Dr. T. C. Carter, Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell.

5.15. p.m. High Tea.

6.30 p.m. Annual General Meeting of the Animal Technicians Association.

Wednesday, April 15:

Chairman: Dr. C. R. Austin, National Institute for Medical Research, Mill Hill, London.

9.30 a.m. Animal Post-Mortem Techniques, by Mr. T. Todd, Ministry of Agriculture for Northern Ireland, Veterinary Research Division, The Farm, Stormont, Belfast.

10.10 a.m. An Apparatus for Producing Lesions in the Hypothalamus of Rats and the Studies of Rats thus Treated, by Mr. R. A. Spires, Department of Experimental Medicine, Cambridge.

10.50 a.m. Coffee.

11.20 a.m. A Method of Producing Inbred Strains of Mice, by Miss D. Bartlett, Miss N. Horne, Miss J. Kettle, and Miss P. Oliver, Laboratory Animals Centre, Carshalton.

12 noon. Trade Exhibition Open.

12.30 p.m. Lunch.

From 1.45 p.m. Visits: *Party A:* London Zoo; *Party B:* E. K. Bowman Ltd., London. (Cage manufacturers); *Party C:* Central Veterinary Laboratory, Weybridge; *Party D:* G. Dixon & Sons, Ware. (Diet manufacturers).

The Congress will be followed on April 16 by a Symposium on Quality in Laboratory Animals which will also be held at the Royal Veterinary College. The provisional programme is as follows:

Chairman: Dr. J. S. Paterson, Ministry of Supply Establishment, Allington Farm, Porton Down, Salisbury.

9.30 a.m. Opening Remarks by Chairman.

9.45. a.m. The Investigation of Specific Responses in Laboratory Animals, by Dr. Annie M. Brown, Laboratory Animals Centre, Carshalton.

10.15 a.m. Coffee.

11 a.m. Establishing and Maintaining a Colony of Specific Pathogen Free Mice, Rats, and Guinea-Pigs, by Dr. D. G. Davey, Imperial Chemical Industries Ltd., Pharmaceuticals Division, Alderley Park, Macclesfield.

11.30 a.m. The Achievements of Selective Breeding, by Dr. D. S. Falconer, Institute of Animal Genetics, University of Edinburgh.

12 noon. Nutritional Factors Affecting Quality in Laboratory Animals, by Mr. A. N. Worden, Nutrition Research Unit, Huntingdon.

12.30 to 2.30 p.m. Lunch, and Trade Exhibition Open.

2.30 p.m. Latent Infections in Laboratory Animals: Their Importance and Control, by Monsieur E. Sacquet, Centre de Sélection des Animaux de Laboratoire, Gif-sur-Yvette, France.

3 p.m. Pathological Changes in old Rats in Relation to Chronic Toxicity Tests, by Dr. P. N. Magee, Toxicology Research Unit, Charshalton.

3.30 p.m. Summary by Chairman.

News from the British Association of Chemists

Legal Aid

One of the most valuable of the services which the B.A.C. gives to its members is free legal advice and, should the matter concerned be of a type affecting the interests of the members generally, free legal aid also. This is a service which has been give for many years now and one in which the Association's Legal Aid Department has acquired a great deal of experience. Over 30 years ago the principle was established, in a case concerning a B.A.C. member, that a chemist was entitled, in the absence of any agreement to the contrary, to three months notice of the termination of his appointment.

Since that time there have been many instances where member's appointments have been terminated without a sufficient period of notice. In the great majority of cases it has not been necessary for the matter to be taken to court in order to obtain the appropriate compensation. This has been due to the work of the B.A.C. in connection with the establishment of the principle and its confirmation on the few subsequent occasions when the case had to be taken to court. It is interesting to note that the Members concerned were not always academically qualified. In more than one of these cases the General Secretary of the B.A.C. and another member were in court for the purpose of testifying to the plaintiff's membership of the B.A.C. and as to his competence as a chemist.

Although two or three times in each year it has been necessary for the B.A.C.'s Legal Aid Department to intervene on behalf of a member whose appointment has been terminated without sufficient notice, the matter is not generally noticed because it is settled out of court. It is now some years since it has been necessary to take a case to court. This particular case was interesting in that most of the senior employees of the organization concerned were paid weekly. It appeared that the employers relied on this to enable them to terminate the appointment quickly if they wished to do so. A B.A.C. member who was the Chief Chemist there was given one week's notice. He reported the matter at once to the Association; application was made to the employers for suitable compensation and they refused to do anything further. The member, on being advised that a writ should be issued, said that he could not afford to take the risk of being liable for costs if the action failed. It was pointed out to him, however, that in this case the B.A.C. was prepared to guarantee the costs and proceedings were therefore instituted. The result was that the member was awarded three months salary and costs.

It must be emphasized that matters upon which members have sought the services of the Association's Legal Aid Department are not confined merely to cases of the above nature. Members are entitled to this service in matters concerning their employment generally. Another type of case is that involving the payment of adequate compensation where members have suffered injury in the course of their work, and members have benefited financially to a considerable extent through being members of the B.A.C. In this type of case it is important that the individual should be properly represented as the employer will usually have insured against this liability. The insurance company concerned will, quite properly, endeavour to effect the most favourable settlement from their point of view. Quite apart from the fact that the members concerned benefit financially, there is the enormous advantage of being able to unload their troubles on to competent shoulders without any cost to themselves.

Another aspect of the legal advice service is that concerning the examination of service agreements. Any member of the B.A.C. can, if he is called upon to sign a service agreement, have it 'vetted' by the Association's Legal Aid Department free of charge. This is a most useful service. Today these are often very complex documents, and the average chemist may well find them very difficult to understand. We always endeavour to impress upon our members the importance of submitting such an agreement to us before he actually signs it. This is not to say that all agreements necessarily include objectionable clauses, but it is very important that the chemist should know beforehand exactly what are his rights and duties under the agreement. The foregoing remarks are not to be taken as indicating that the B.A.C.'s Legal Aid Department is for the purpose of encouraging the 'Employer Versus Employee' complex. It is the aim of the B.A.C. to promote truly equitable arrangements between employers and chemists in all matters. In actual fact, employers do, from time to time, approach the B.A.C. for advice in the matter of service agreements.

One of the more difficult matters to be dealt with in service agreements is the 'Restraint' clause. Under this the employer seeks to prevent the employee, if he leaves his employ, from engaging without his permssion in a particular line of work with another organization. There may be a specified period during which this restraint is to operate. The general principle is that the employer is entitled to safeguard his particular secrets and special knowledge in a particular direction against his competitors. On the other hand the employee must not be put in such a position that he cannot earn his living by the exercise of his profession. The usual solution is an undertaking by the employer to pay to the employee a proportion of the salary, which he was receiving when he left, during the period when the restraint clause is invoked and this is sometimes a difficult matter to assess.

In conclusion, it should be pointed out that the B.A.C. is the only chemical professional association for individual chemists which can perform this kind of service for its members. B.A.C. members have obtained, through our Legal Aid Department, as much as £1,500 in compensation for loss of office and, in the case of injury sustained while working, compensation amounting to £3,000, when the original offer was £900.

Obituary

Bowker, F.C., aged 78. Elected M. 1919. L.M. 1951, Northern.

Davies, W. T. G., aged 65. Elected M. 1927, Bristol and S.W.

Read, F. W., aged 75, Elected M. 1919. L.M. 1945, Bristol and S.W.

Life Member

The undermentioned has been elected a life member of the Association:

Gay, A. D., elected member 1927, Bristol and S.W.

Section Programmes

Notts and Derby

A lecture entitled 'Photoelectric Colorimeters, Their Uses and Limitations in the Dyehouse' will be given by J. V. Alderson, Esq., B.Sc., A.R.C.S. at the Midland Hotel, Derby on Wednesday, March 18, 1959, at 7. p.m This has been arranged jointly with the Society of Dyers and Colourists.

Liverpool

A visit to the Lockheed Hydraulic Brake Co. Ltd., Speke, has been arranged for Tuesday, March 24, 1959, at 7 p.m.

London

A film show will be held comprising 'Rig 20' (B.P.) 'Back of Beyond' (Shell) and 'Accent on Carpet' (Carpet Trades Ltd.), at the Wellcome Research Institute, Euston Road, N.W.1, at 7 p.m. on Wednesday, March 11, 1959.

A most interesting lecture was recently delivered to the members of the Section by Mr. G. B. Cook, of the Atomic Energy Research Establishment, Harwell, which was entitled 'The Use of Isotopes in Industry'. This function was held at the Wellcome Institute, Euston Road, N.W.1.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

Laboratory Note-Book

DIABINESE (chlorpropamide), the new oral hypoglycaemic agent developed and produced by Pfizer, is now generally available to physicians; previously it had been reserved for use in diabetes clinics and hospitals.

More potent than any other available oral anti-diabetic drug, its main indication is uncomplicated diabetes mellitus of the stable, mild or moderately severe non-ketotic, maturity-onset or adult type. It is classified as an arylsulphonylurea.

A satisfactory response to Diabinese will be quickly evident by a fall in blood sugar, a diminution in the glycosuria, and disappearance of such symptoms of diabetes mellitus as pruritus, polyuria, and polydipsia and polyphagia. It has been used successfully in some patients suitable for oral hypoglycaemic therapy who have failed to respond to tolbutamide.

Diabinese exerts a hypoglycaemic effect in normal humans within an hour. The effect is maximal at three to six hours and lasts for at least 24 hours after a single dose. Both in normal persons and diabetics, the drug has up to twice the potency of tolbutamide on single dose administration, and up to six times this potency on continued administration.

The total daily dose is generally to be taken as a single dose each morning with breakfast. Most patients are adequately controlled by 200-500 mg. daily, but occasionally a maintenance dose may be as little as 100 mg. daily.

The large majority of diabetic patients for whom oral therapy is indicated can be placed directly on Diabinese at the same time as insulin is discontinued.

Side-effects are generally transient and not serious.

An Odd Job for Glassmaking Firm

One of the most unusual jobs ever tackled by glassblowers at the scientific glassware factory of Quickfit & Quartz Ltd. at Stone has been the production of a glass cricket stump.

The glass cricket stump is dimensionally correct in every respect, is hollow and holds about a pint. Its customary contents will be beer and it will be used by the Little Stoke Cricket Club, as a variation of the well-known yard of ale, to celebrate the scoring of a century, the taking of nine wickets or more in any one match or to mark any signal service rendered by members to cricket. Those who fulfil the conditions will be asked to drink the stump-full of beer without pausing. Those who complete this heroic ceremony will become members of what their club secretary, Mr. Sidney Jenkins, calls 'an exclusive brotherhood'.

Mr. E. S. Pearse, works director of Quickfit & Quartz Ltd., reports that production of the stump produced no particular difficulties for his lampworkers who are well used to even more intricate assignments.

Snake Venoms

It seems that the difficulty of supplying snake venoms has now been overcome. L. Light & Co., Ltd. of Poyle Estate, Colnbrook, Bucks., advise us that they have now located sources, both in the old and new worlds, and could supply dehydrated snake venoms from most of the poisonous snakes.

The venoms which are likely to be available in the near future are:

Puff adder (Bitis arientans).
Spitting cobra (Naja nigricollis).
Black mamba (Dendrastis).
Gaboon viper (Bitis gabonica).
Eastern diamondback rattlesnake (Crotalus adamantens).
Cantil—Mexican moccasin (Agkistrodon bilineatus).
Hooded cobra (Naja naja).
King cobra (Naja hannah).
Russell's viper (Vipera russelli).

Antarctic Research

The first meeting of the newly formed National Committee on Antarctic Research was held on January 27, in the rooms of the Royal Society. The Committee has been set up to co-ordinate British research activities in the Antarctic.

In February 1958 a new body, the Special Committee on Antarctic Research (SCAR), was set up by the International Council of Scientific Unions (ICSU), to arrange for further detailed co-ordination of international Antarctic activities after the close of the International Geophysical Year on December 31, 1958.

The main duty of the new National Committee on Antarctic Research will be to co-ordinate British Antarctic activities in relation to the large scientific programme at present being considered by SCAR. This programme covers such topics as meteorology, ionospheric studies, auroral physics, geomagnetism, cosmic rays, geology, glaciology, geomorphology, cartography, seismology, gravity, vulcanology, oceanography, sea ice, biology including marine aspects and physiology. It is hoped that the Committee will be able to arrange for greater participation by scientific workers from the United Kingdom in research activities in Antarctica.

The United Kingdom delegate on SCAR is Dr. G. de Q. Robin, Director of the Scott Polar Research Institute, who is at present also the Acting Secretary of SCAR.

The next meeting of the Special Committee on Antarctic Research will be held in Canberra, March 2 to 6, 1959.

The National Committee on Antarctic Research is constituted as follows:

Chairman: Sir Raymond Priestley.

Royal Society: Prof. W. V. D. Hodge, Sec.R.S.; Sir Lindor Brown, Sec.R.S.; Dr. H. G. Thornton, For.Sec.R.S.; Mr. A. H. Sheffield; Prof. F. W. Shotton, F.R.S.; Prof. J. E. Smith, F.R.S.; Dr. R. L. Smith-Rose; Dr. R. Stoneley, F.R.S.; Sir James Wordie.

Sir Vivian Fuchs, Scientific Director, Falkland Islands Dependencies Survey.

Brigadier M. Hotine, Director of Overseas Surveys.

Rear-Admiral K. St. B. Collins, Hydrographer of the Navy.

Dr. G. E. R. Deacon, F.R.S., Director of the National Institute of Oceanography.

Sir Graham Sutton, F.R.S., Director-General of the Meteorological Office.

Dr. G. de Q. Robin, United Kingdom delegate to SCAR.

Sir Miles Clifford (Royal Geographical Society).

Dr. E. Hindle, F.R.S. (Royal Geographical Society).

Mr. G. Seligman (British Glaciological Society).

Dr. S. Evans (Scott Polar Research Institute).

Mr. J. Paton (Royal Society of Edinburgh).

Dr. L. G. C. E. Pugh (Medical Research Council).

Mr. H. H. Lamb (Royal Meteorological Society).

SIRA's New Service

The British Scientific Instrument Research Association announce the establishment of an Electrical Instrument Test Service at their laboratories in Chislehurst, Kent. Although originally set up at the request of members of the Association, the Service is now available to other firms and organizations.

Operated under the supervision of the National Physical Laboratory and using N.P.L. certified equipment, the department will test and issue certificates for instruments up to precision grade accuracy. Calibration of d.c. meters between 1mV and 500V and between 2μA and 2A can be undertaken immediately. In the near future the latter range is to be extended up to 25A, and the calibration of a.c. instruments over the ranges 1V to 500V and 10mA—25A will be undertaken. Charges for the service will be appreciably less than the cost of N.P.L. certification.

It is expected that this service will be welcomed by both manufacturers and users of instruments in this country particularly where an independent test certificate for an instrument is required but where the prestige value of an N.P.L. certificate is unnecessary.

Further information may be obtained from The Director of Research, The British Scientific Instrument Research Association, South Hill, Chislehurst, Kent.

LABORATORY EQUIPMENT & APPLIANCES

New Liquid Level Controller

Designed primarily to maintain a constant level in the fountain solution tray of lithographic presses, the new liquid level controller Model No. 614, can be used with all types of liquids wherever a constant level is required to be maintained.

As all parts coming into contact with the solution are resistant to corrosive action, the flow to the tray cannot be restricted through eroded deposits and the frequent flushing of the feed is obviated.

The solution level is maintained at the desired level and can easily be adjusted to another level if required. There is no possibility of the tray overflowing.

The one gallon Polythene bottle holding the liquid is fitted into a mild steel holder designed to carry the whole weight of the bottle without any strain being transmitted to the valve. The bottle holder is secured to the main bracket but can easily be removed to enable the unit to be fixed to the machine. This is accomplished by fixing two set screws through the bracket, slotted holes being provided to enable slight adjustments in level to be made.

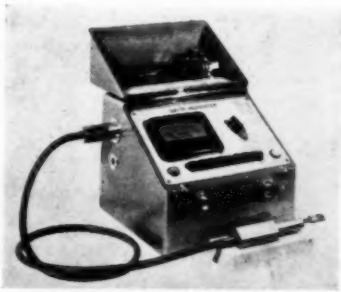
The reservoir cup is aluminium (P.V.C. coated) and is fastened to the aluminium main bracket.

The valve is spring loaded to prevent loss of fluid when inverting the container, and opens automatically when the container is replaced in position in its holder. All valve parts are in stainless steel, any other parts coming into contact with the fluid being either stainless steel, Polythene or aluminium P.V.C. coated.

The unit is supplied complete with 5 ft. Polythene tubing, two stainless steel hose connectors and worm drive clips; a brass adaptor is also provided for brazing to the tray of the machine.

(Manufacturers: Liquid Systems Ltd., Norwich Union House, Wellesley Road, Croydon, Surrey.)

The new liquid level controller.



The Diavite Microtester.

The Diavite Microtester

A Swiss instrument for testing surface finish is now available in this country. Known as the Diavite microtester, this instrument is sturdy and simple to operate, gives fast surface finish measurements and is therefore a handy and useful instrument for the workshop. The high accuracy and repeatability of readings also make it suitable for laboratory use.

(Available from: Payne Products International Ltd., Lawrence Estate, Green Lane, Hounslow, Middlesex.)

High Vacuum Pumps

Details have been received of a range of high vacuum pumps specifically suited to the exacting requirements of laboratory conditions, namely: absolute reliability and consistency of performance, freedom from vibration, silent running and an exceptionally low ultimate.

The advanced design has enabled the manufacturers to produce a range of high-efficiency rotary piston pumps for vacuum equipment used in many branches of scientific research—industrial, medical, educational and also in manufacturers' standard productions.

The Genevac high vacuum rotary piston pump.

The photograph shows the 'Genevac' single stage high vacuum rotary piston pump which is in 2, 4, 8 and 12 cu./ft./min. capacity with an ultimate vacuum of less than 0·005 m/m Hg. The double stage model is in 2, 4 and 6 cu./ft./min. capacity with an ultimate vacuum of less than 0·0002 m/m Hg. The design permits of higher pumping speeds at 100 microns and the pressure rise is less than 0·5 m/m Hg. with maximum ballast. The necessity for oil changes is reduced to a minimum due to the oil circulation filter system.

(Manufacturers: Genevac Ltd., Radcliffe, Lancs.)

Microscope Slide Filing Cabinets

Technicon 'Lab-Aid' microscope slide filing cabinets are now available in the United Kingdom.

These cabinets are mainly used in histology and pathology departments for the filing of microscope slides for either reference or record purposes. This laboratory filing system is built up on a unit basis and can be added to as the number of slides increases. Its great advantage is economy of space; one 19 in. × 19 in. unit section holds up to 6,500 one inch microslides. The system is flexible in that it will provide 'spaced' filing for current slides, and close-packed storage for older specimens. The spring liner lets the user choose either way at will.

A further important application for these cabinets is for the filing of lantern slides and Kodachrome transparencies.

(Agents: Technicon Instruments Co. Ltd., 26 Warwick Road, London, S.W.5.)

Laboratory Scaffolding

As additions to the wide range of laboratory scaffolding two new boss-heads have been developed giving even greater flexibility to an already useful laboratory aid. These new items con-

stitute a considerable advance and at once overcome several difficult features met in conventional structures.

The first of these is a scaffolding bosshead or connector used for fixing together the frame components. Made of whiteheart malleable iron and finished in heavy cadmium plate, the bosshead has two recesses at alternate ends at right angles to each other. Into each recess the scaffold rod can be fitted either horizontally or vertically where it is secured with a plated brass screw having a sliding tommy bar in its head. This enables the rod to be positively clamped and removes any need for keys to tighten the retaining screws. The bosshead may be fitted within any scaffold assembly with ease.

The second innovation is a truly universal bosshead which permits movement through any angle. Constructed in brass and finished nickel plated it is made in two pieces which are fitted together with a male/female type joint. At the end of each section away from the joint is a recess which carries the scaffold rods either horizontally or vertically. Three retaining screws are fitted, one each for the scaffold rod recesses and one for the central joint, the screws being of the tommy bar pattern described above. Using this bosshead a rod or clamp can be turned through any angle in any plane giving complete flexibility to the scaffold assembly and yet retaining the rigidity necessary to support complex glass apparatus.

Patents are pending for both the above bossheads. Descriptive literature is available and will be sent on request.
(Manufacturers: R. & L. Enterprises Limited, Grangefield Road, Stanningley, Leeds. All enquiries to: Ralph Cuthbert Limited, Westgate, Huddersfield, the sole U.K. concessionaires).

Rapid S.N.F. Calculator

As a further contribution to automation in the laboratory, a rapid solids-not-fat calculator has now been developed. This has been designed to replace the unwieldy British Standards Tables, and to ensure speedy and accurate direct reading of the solids-not-fat for milk of any given density and fat percentage. Used in conjunction with Astell hydrometers and other accessories already well known, it will be possible to speed up and improve the efficiency of milk testing.
(Manufacturers: Astell Laboratory Service Co. Ltd., 172 Brownhill Road, Catford, London, S.E.6.)

The new rapid solids-not-fat calculator, developed by the Astell Laboratory Service Co. Ltd., can be used in conjunction with the company's hydrometers and other accessories.

CATALOGUES, BROCHURES & LEAFLETS

Received from Manufacturers

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd. of Poole, Dorset, are listed in the November 1958 issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Barium chloranilate; 2-chloro-pyridine; 3:3′ -diaminobenzidine tetrahydrochloride; 2:3-epoxypropanol (glycidol); phenyl-succinic acid *Solutions for Analytical Use.*—Lithium methoxide solution N/10.

In the December 1958 issue of their monthly leaflet, these are as follows: *Organic and Inorganic Chemicals—m*-Amino-benzo-trifluoride; amylopectin from potato starch; 1:2-dimethoxyethane; oxalyl dihyazide; odium hydrozide flake; dl-α-tocopherol acetate.

The January issue contains the following: *Organic and Inorganic Chemicals.*—*p*-amino-*N*:*N*-dimethyl-aniline oxalate; 1-chloro-methyl-naphthalene; ethanolamine-phosphoric acid; ethanolamine-phosphoric acid barium salt; homomenthyl salicylate.

The Control of Algae in Water.—A leaflet describing the control of algae in water by means of Algistat has been published by the manufacturers, British Drug Houses Ltd., Poole, Dorset.

Injection Moulding Materials.—A booklet describing the general characteristics, types available and uses of the BX injection moulding materials has been published by B.X. Plastics Ltd., of Higham Station Avenue, Chingford, London, E.4.

Electric Muffle Furnaces.—A.E.W. Ltd. of Imperial Works, High Street, Edgware, Middlesex, have issued a leaflet describing their new range of electric muffle furnaces for laboratory and workshop use.

Instrument Catalogue.—A catalogue of their electrical and electronic testing instruments is available on application to Avo Ltd., Avocet House, 92-96 Vauxhall Bridge Road, London, S.W.1.

Molybdenized Lubricants.—A new edition of a comprehensive guide to molybdenized lubricants has now been published by Rocol Ltd., Rocol House, Swillington, near Leeds.

Hilger Journal.—The August 1958 issue of the *Hilger Journal* (Vol. 5, No. 1) published by Hilger & Watts Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1 contains articles on 'Statistical Procedure in Relation to Spectrochemical Analysis' by A. B. Calder, B.Sc., Ph.D., F.R.I.C. and 'Atomic-absorption Spectroscopy'.

Hydrometers and Hydrometer Accessories.—The Astell Laboratory Service Co., Ltd. 172 Brownhill Road, Catford, London, S.E.6, have issued a new and comprehensive leaflet dealing with hydrometers and hydrometer accessories. It covers hydrometers for milk testing, a rapid solids-not-fat calculator, automatic water bath, hydrometer jars, automatic lactometer jars, Baumé hydrometers, brinometers, specific gravity hydrometers, Twaddell hydrometers, urinometers and battery hydrometers.

Measurement of Atmospheric Pollution.—The Mervyn-Cerl automatic sulphur dioxide recorder for continuous measurement of atmospheric pollution is described in a new leaflet issued by the manufacturers—Mervyn Instruments Ltd., St. John's, Woking, Surrey.

NEWS

General

Combustion Methods in Organic Micro-Analysis

A series of Special Lectures on Friday evenings at 6 p.m. will be held at Norwood Technical College, Knight's Hill, London, S.E.27, with associated practical work on Saturday mornings.

Friday, March 6, 1959. 1. *'Conventional' Methods* (P. R. W. Baker, M.Sc., A.R.I.C.).

Saturday, March 7, 1959. Historical introduction; Determination of C, H, N, Halogens, S and O.

Friday, March 13, 1959. 2. *Rapid-flow Empty Tube Methods* (G. Ingram, A.R.I.C.).

Saturday, March 14, 1959. Determination of C, H, N, Halogens and S.

Friday, March 20, 1959. 3. *Recent Developments* (P. R. W. Baker, M.Sc., A.R.I.C.).

Saturday, March 21, 1959. The Schöniger oxygen flask technique; Determination of 2 or more elements simultaneously; Vacuum techniques; Ultra micro-analysis.

It is hoped to include in the practical work the determination of C and H, by the Pregl and Ingram methods; N by Dumas and Kjeldehl; I by dry combustion and the Schöniger method; S by the Schöniger method.

London fee for the course is 10s. Applications for admission should be made to the Secretary, Norwood Technical College.

Achema, 1961

The Achema 1961, Thirteenth Exhibition Congress of Chemical Engineering organized by the DECHEMA, will be held in Frankfurt a.M. from June 9 to 17, 1961. It will once again include the following groups of exhibits: research and literature, new chemical substances, nuclear science and techniques, laboratory techniques, measurement control and automation techniques, structural materials techniques, works techniques, pumps and fittings, packaging techniques, auxiliary materials and consumable stores, accident prevention and works safety precautions.

Glass in Nuclear Research

Important developments in nuclear research in recent years have meant an increased demand for viewing windows to permit clear observation of operations or objects within the bounds of the 'hot' cell walls, and also to facilitate the remote handling of radioactive materials, while providing protection for the operatives.

Just as ingenious mechanisms have been evolved for remote handling, so have special types of glass been produced for shielding windows. In the forefront in this field is the Chance-Pilkington Optical Works at St. Asaph, North Wales, which has now developed radiation absorbing glasses of larger dimensions than have been available hitherto in Europe.

Particularly at very short wavelengths, the attenuation offered by protective walling is proportional to the density of the material employed. The Chance-Pilkington shielding glasses range in density from 2·5 g. per cc. to 6·1 g. per cc., and allow the design of windows to be, in many cases, of equal thickness to the surrounding wall, thereby reducing the complexity of additive shielding and obtaining the maximum optical advantage from the window.

Upon receipt of large dosages of short wavelength radiation, glasses of normal composition tend to discolour to a deep yellow or brown. To overcome this, Chance-Pilkington manufacture a series of glasses which are stabilized. These glasses have amended compositions having the effect of slightly decreasing the transmission of the glass in the unirradiated state, but reducing the tendency for further discoloration under conditions of radiation.

Shielding glasses of density 2·5 g. per cc. and 4·3 g. per cc. are manufactured in polished plate form and also in block form up to 4 ft. 6 in. by 3 ft. in area and 10 in. in thickness, with the limitation for the time being that no single block shall weigh more than 2,000 lb.

There is available to all users a Chance-Pilkington design and advisory service which will consider specific requirements and design complete composite glass shielding windows, fully framed. These windows will thus be despatched in a form which will permit immediate and simple installation into the shielding wall upon arrival at site, and if required technical staff will be available to supervise installation.

Publications

Hydraulics Research

The Hydraulics Research Station, Department of Scientific and Industrial Research, is introducing a new series of Research Papers. The first two, which have now been published, deal with the flow of water in open channels and pipes.

During the past 200 years the flow of water in channels has been studied extensively and a large number of formulae has become available to the design engineer. However, as these formulae are generally of limited application, designers have experienced difficulty in selecting formulae appropriate to their requirements and much confusion has been caused. In the 1930's, Dr. Colebrook and Prof. White working at Imperial College, London, employed the then new theories of turbulence to bring almost all the problems of hydraulic friction within the scope of one equation. This equation is recognized as the best yet devised but unfortunately it has proved to be too complex to be popular with the average design engineer. Attempts have been made in several countries to express it in an easily useable form but none was completely successful.

The Hydraulics Research Station has now solved the difficulty by developing the formula so that it can be expressed in graphical form. Paper No. 1 (price 8s. 6d.) gives this development after fully reviewing and discussing the subject of hydraulic friction. Paper No. 2 (price 12s.) contains 28 design charts, based on this development of the Colebrook-White formula, covering a wide range of conditions, materials of construction and cross-sectional shapes for conduits ranging from 80 ft. diameter hydro-power tunnels down to 1 in. diameter copper piping. Many examples of hydraulic designs are given in this publication, including an oil pipe line, concrete-lined channels of rectangular and trapezoidal cross sections and storm drains flowing with a free-water surface.

Opportunities for Graduates

Another edition of The Directory of Opportunities for Graduates, published by the Cornmarket Press Ltd. (price 8s. 6d.) has now been published. The aim of this annual reference book is to provide Britain's 20,000 graduates per year with a clear and extensive picture of the opportunities which exist for them. To this end the reference section sets out in detail information about commercial and industrial organizations, government departments, and their requirements.

The classified index lists firms under headings which describe their activities and provides potted information about them.

Personal Notes

N.I.R.D. Appointment

Prof. Ronald Gilbert Baskett, O.B.E., M.Sc., F.R.I.C., has been appointed Director of the National Institute for Research in Dairying, University of Reading, from August 1, 1959.

Prof. Baskett is at present Professor of Agricultural Chemistry, The Queen's University of Belfast, and Head of the Chemical and Animal Nutrition Division of the Ministry of Agriculture for Northern Ireland. He was born in 1901, and educated at King Edward VI Grammar School, Chelmsford and University College, Reading.

Manufacturers' News

Redesigned Instrument Showroom

For many years Cambridge Instrument Company Ltd. have had the problem of displaying modern industrial and scientific apparatus in a Georgian setting.

Their showroom at 13 Grosvenor Place, London, S.W.1 has now been completely redesigned and redecorated in modern style. Tasteful new furniture has been installed, and, most important of all, the instruments shown are the latest models, mounted on well-designed easily accessible fixtures and showcases.

Lighting problems were solved with the co-operation of The General Electric Company Ltd., Maple & Co. Ltd. supplied part of the furniture, and H. Benfield Ltd. carried out the decoration.

Visitors, particularly from overseas territories, will be welcome, and will be able to discuss their instrument problems with experienced members of the staff.

Telex for Griffin & George

Griffin & George (Sales) Ltd., the laboratory furnishers, advise that their offices and warehouse at Cheetham Hill Road, Manchester, 4, are now connected to the Telex system on Telex 66-450.

Beckman Process Control Instruments

A successful and well-attended series of demonstrations were given recently at the Abercorn Rooms, Gt. Eastern Hotel, London, E.C.2, during which A. Gallenkamp & Co., Ltd. showed some of the instruments of the industrial process type manufactured by Beckman Instruments Inc.

Of chief interest was the industrial gas chromatograph for monitoring four components in up to 10 streams on plant. In the demonstration commercial propane was analyzed, using a double column and hydrogen as the carrier gas. Visitors remarked on the steadiness of the zero line and the high reproducibility of peak height.

Also on show were an electrolytic hygrometer for monitoring stream humidity up to 1,000 p.p.m., a dissolved oxygen analyser with a sensitivity of 25 parts per thousand million for boiler water feed, a portable paramagnetic oxygen analyzer and a laboratory gas chromatograph.

Following these London demonstrations, the instruments were taken to a number of industrial firms for actual plant trials. The applications for which they were being tried included such streams as wind tunnel air, oil refinery gas flows, and coolant gases for nuclear reactors.

Information on Beckman Process Control Instruments can be obtained from the sole British agents, A. Gallenkamp & Co., Ltd. Sun Street, London, E.C.2.

Laboratory Glassware

H. J. Elliott, Ltd. announce that it is just 10 years since they introduced the E-Mil Gold Line and Green Line Brands of volumetric glassware and thermometers.

Of the total production of these Brands, 40 per cent is exported direct to dealer houses in many parts of the world, apart from those exported by Elliott's U.K. stockists and distributors. The demand for E-Mil Brands is such that it now accounts for the major portion of the company's overall production capacity, which has been expanded twelvefold since 1939, and is still expanding.

A New Company

Griffin & George (Research and Development) Ltd., has been formed by the Griffin & George Group to conduct research into, and the development of, new and improved scientific instruments and apparatus for laboratory use and process control.

The Research Director is Dr. A. J. P. Martin, F.R.S., well known for his work on partition chromatography, acknowledged by the award in 1952 of the Nobel Prize for chemistry (jointly with Dr. R. Synge).

New laboratories to house the research and development staff will be designed and equipped. A major part of the company's effort will be directed towards a review of modern analytical techniques and the development of the instruments and apparatus for applying them in the laboratory and on the plant.

At the same time, in view of its importance in educating the scientists of the future, work will be conducted on modernizing and extending the Group's range of apparatus for use in the science laboratories of Schools, Technical Colleges and Universities.

MEETINGS FOR THE MONTH

Mid-March to Mid-April

We give below a selection of meetings of interest to laboratory workers. Details are as full as possible at the time of going to press, but readers requiring further information or confirmation of arrangements should contact the organizers.

March 10

The Society for Analytical Chemistry (Midlands Section). At the Gas Showrooms, Nottingham. 7 p.m. 'The Microbiological Assay of the B Vitamins', by Dr. F. W. Norris.

The Society of Instrument Technology (Cheltenham Section). At the Rotunda, Cheltenham. 7.30 p.m. 'Instrumentation on the Trans-Antarctic Expedition'.

The Society of Instrument Technology (Manchester Section). At the Manchester Room, Central Library, St. Peters Square, Manchester 1. 6.30 p.m. 'Electro-magnetic Flow Meters', by L. M. Bennett.

March 13

Royal Institution of Great Britain. At 21 Albemarle Street, London, W.1. 9 p.m. 'On Bombarding Solids with Neutrons', by Dr. H. M. Finniston.

The Society for Analytical Chemistry (Western Section). At Swansea. Joint meeting with the South Wales Section of the Royal Institute of Chemistry on 'New Techniques in Qualitative Analysis', by D. W. Wilson.

March 18

The Physical Society (Colour Group). 'How Reproducible are Standard Illuminants?' by A. W. S. Tarrant.

March 19

The Physical Society (Optical Group). Annual General Meeting and Science Meeting.

The Society of Instrument Technology (East Midland Section). At the College of Technology and Commerce, The Newarke, Leicester. 6.30 p.m. Forum on 'Accuracy of Instruments'.

The Society of Instrument Technology (Tees-Side Section). At the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. 7.30 p.m. 'Flow Measurement: Some Problems and Devices of Special Interest', by Dr. W. J. Clark. Annual General Meeting.

March 20

Royal Institution of Great Britain. At 21 Albemarle Street, London, W.1. 9 p.m. 'Man as a Controller of Flight Vehicles', by Air Commodore W. K. Stewart.

The Society of Instrument Technology (Scottish Section). At the Scottish Building Centre, 325 Sauchiehall Street, Glasgow. 7.15 p.m. Annual General Meeting.

The Society for Analytical Chemistry (Midlands Section). At the University, Birmingham, 3. 6.30 p.m. Joint Meeting with the Physical Methods Group of the Society on 'X-ray Fluorescence'.

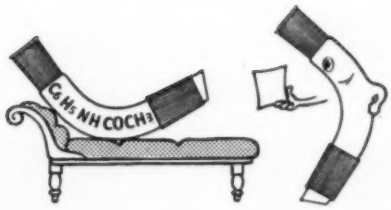
March 24

The Physical Society (Acoustics Group). At Imperial College, London. Annual General Meeting and symposium on 'Recent Studies of Noise Problems'.

April 7

The Physical Society (Acoustics Group). At Southampton University. Symposium on 'Noise Analysis'.

Analysing organic compounds?



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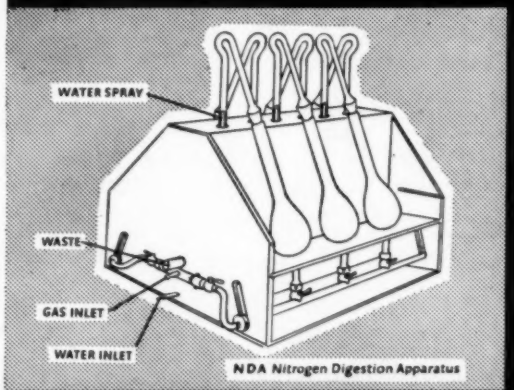

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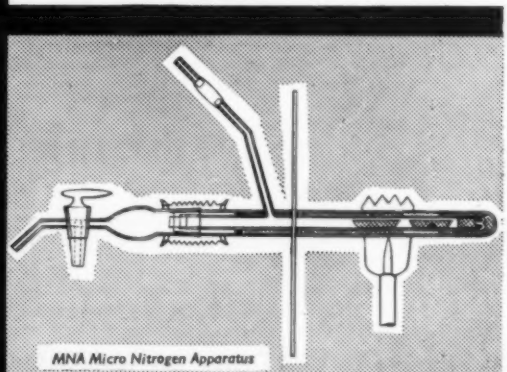
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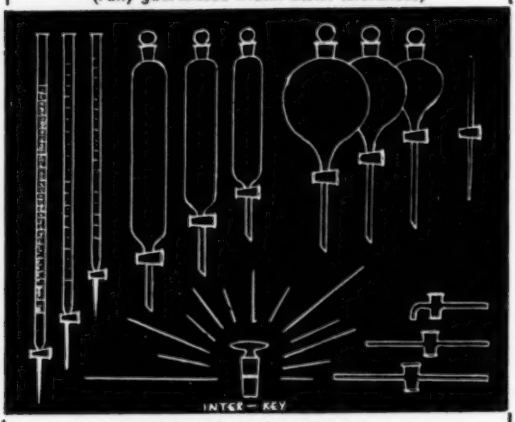

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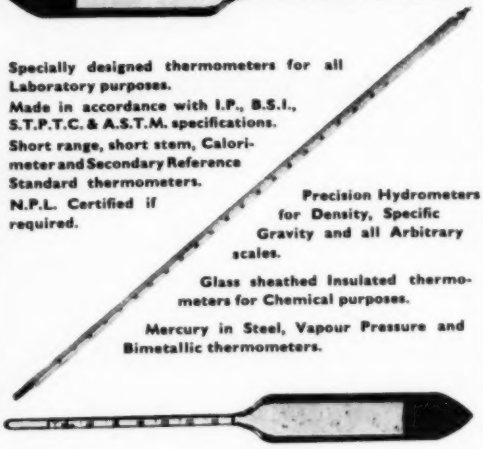

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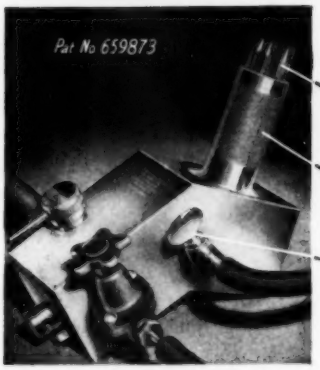

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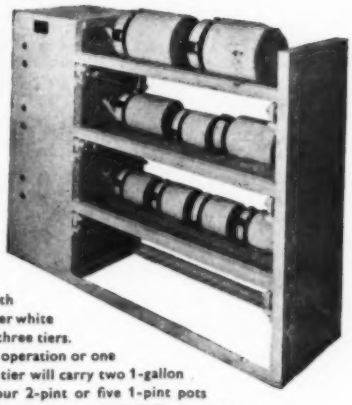

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